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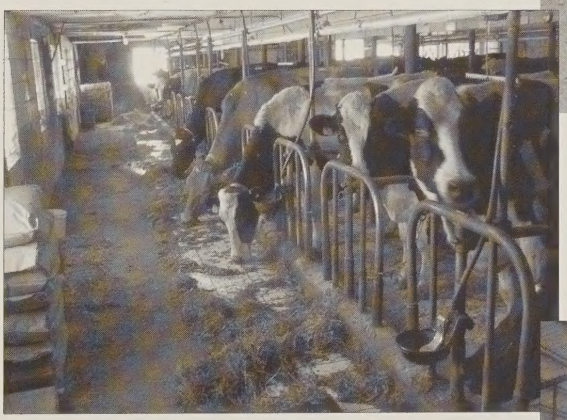
Dairy 2007

Facility Characteristics and Cow Comfort on U.S. Dairy Operations, 2007



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Cover photograph of man with pail courtesy of Hibbard Studio Photo.
Photograph of cattle in tie-stall facility courtesy of Jeffrey Hoffelt.
Other photographs courtesy of Dr. Jason Lombard.

Items of Note

More than four of five dairy cows in the United States were raised on conventional dairy operations in which the majority of forage was harvested and delivered to the cows. About one of three operations was a combination of conventional and grazing operations types.

During the last 50 years, housing types on U.S. dairies have changed from predominantly stanchion facilities to tie stalls, freestalls, and dry lots. In 2007, almost three of four lactating cows were housed in freestall or dry lot/ multiple-animal areas, and these cows were milked in parlor facilities. The more modern housing types allow cows more freedom of movement compared with the traditional tie-stall and stanchion facilities. Data from the Dairy 2007 study indicate that freestall housing provided an environment that promoted improved hygiene and reduced hock injuries; however, freestall facilities had the highest percentage of cows with lameness compared with other housing types. Unless allowed access to dry lots or pasture, cows in freestall housing were typically on concrete flooring, which may have contributed to the increased lameness reported.

On tie-stall and stanchion operations, cows have their own stall where they eat, drink, and rest, so space allotment in square footage per cow, cows per stall, feedbunk space, and cows per headlock is not applicable. In freestall housing, all cows are not typically doing the same activity, so it is not necessary to have the same amount of stalls, bunk space, or headlocks, if present, for all the cows in the pen.

Freestall features

The type of freestall barn impacts the ratio of stalls to feed bunk space or, if present, headlocks. Two- and four-row barns provide more feed bunk space and square footage per cow than three- or six-row barns. More than 6 of 10 freestall barns were two- or four-row barns. Research indicates that having up to 10 percent more cows than stalls in a pen (1.1 cows per stall) does not affect the cows' behavior. At the time of the Dairy 2007 assessment, about 7 of 10 freestall operations had less than 1.1 cows per stall. However, when these operations were at maximum cow numbers, only 5 of 10 had less than 1.1 cows per stall. On freestall operations with headlocks, about one-third of operations had less than one cow per headlock at the time of the assessment, and when at maximum cow numbers, about one of six operations had less than one cow per headlock.

Stall management

Stall management is important in providing a clean, comfortable place for cows to lie down. One of the most important aspects of stall management involves the stall base (floor upon which bedding is added) and bedding. Typical stall bases are composed of concrete, dirt, rubber mats, and mattresses. Straw, sawdust, sand, or combinations of the three were the most common bedding types for all housing types.

Stall base, bedding type, and management differed by housing type. Tie-stall and stanchion operations primarily used concrete, rubber mats,

and mattresses as stall bases. In general, tie-stall and stanchion operations used straw or sawdust as bedding and changed or added bedding every 1 to 2 days. At the time of the Dairy 2007 assessment, the stall base was exposed—not covered by bedding—on about three of four operations with tie-stall and stanchion housing.

For operations with freestall and other multiple-animal area housing (including dry lots), the most commonly used stall bases were concrete, dirt, and mattresses. The most common bedding used on these operations were straw, sawdust, sand and, in the case of other multiple-animal areas, none. Bedding on freestall and other multiple-animal area housing was added or changed less frequently than on tie-stall or stanchion housing. However, even though these operations added/changed bedding less frequently than tie-stall or stanchion operations, at the time of the Dairy 2007 assessment the overall bedding quality/stall condition was better in freestall housing because a higher percentage did not have exposed stall bases.

Cow health

Housing type did appear to have an influence on the health of dairy cows. Although freestall and other multiple-animal area housing improve production, hygiene, and reduce hock injuries, health problems still exist in these housing types. While more clinical mastitis, infertility, and displaced abomasums were reported on tie-stall and stanchion operations, a higher percentage of lameness was reported for cows on freestall operations. A lower percentage of cows on stanchion operations were permanently removed compared with cows on tie-stall or freestall operations. Mastitis accounted for a higher percentage of cow deaths on freestall operations and operations with other multiple-animal areas compared with stanchion operations.

Hygiene scoring

Hygiene is important in reducing cows' exposure to pathogens, especially in regard to mastitis and lameness. Features of cow housing generally thought to improve cow hygiene include bedding and bedding management, and the presence of neck rails, brisket locators, gutter grates, and cow trainers.

There were no differences by housing type in the percentages of cows with hygiene scores of 1 (clean). A lower percentage of cows had a hygiene score of 3 (dirty) on freestall operations compared with cows on tie-stall, stanchion, and dry lot operations. The higher percentage of cows with hygiene scores of 3 on tie-stall, stanchion, and dry lot operations might be due to the fact that cows on these operations typically have access to dirt or pasture. Hygiene on freestall operations, in which cows are not allowed on dirt or pasture, is dependent on freestall and alleyway management.

The use of concrete or rubber mats as stall bases was associated with poorer hygiene compared with the use of dirt or mattresses as stall bases. The use of coarse sand or dried or composted manure was associated with better hygiene compared with the use of other bedding types. Deep, well-bedded stalls were also associated with cleaner cows compared with stalls with less bedding. Moveable neck rails were associated

with a higher percentage of cows with hygiene scores of 1, but the horizontal distance from the curb or the vertical distance from the bed did not influence cow hygiene. There were no consistent trends in the effect of brisket locators on hygiene scores; operations that used wood locators had a higher percentage of dirty cows compared with the operations that did not use any brisket locators. The use of gutter grates and cow trainers were both associated with improved hygiene

Hock scoring

Hock injuries are generally assumed to be related to the surfaces upon which cows lie. Cows housed in dry lot facilities and other multiple-animal areas where cows lie primarily on dirt had the highest percentage of cows without hair loss or lesions of the hocks (hock score=1). Hock lesions were generally more prevalent in tie-stall and stanchion housing types. Stall bases constructed of concrete, mattresses, and rubber mats were associated with increased hock lesions compared with dirt stall bases. Typical bedding types used in freestalls and facilities that generally do not use bedding (e.g., dry lots) were associated with better hock scores than facilities that bedded primarily with straw or sawdust (e.g., tie-stall and stanchions). Hock scores of 1 increased with the days since bedding was added, which was highly associated with housing type and bedding type. Fewer hock lesions were observed when bedding quantity was good and the stall base was not exposed than when bedding quantity was poor and the stall base was exposed.

Comfort parameters

Four comfort parameters were assessed during the study: perching (standing with the front feet inside the stall), standing (with all feet inside the stall), lying, and the cow comfort index (CCI), which is the proportion of cows in contact with a stall that are lying down. These comfort parameters were evaluated only on freestall operations or operations with other multiple-animal areas that included a combination of freestalls and other housing types, such as dry lots. Since cows spend almost 12 hours a day lying, it is important that they do not spend an inordinate amount of time perching or standing in the stall, although cows entering and leaving stalls are included in these two categories. Bedding type and management and specific stall features such as neck rails, brisket locators, stall length and width, and temperature have been shown to influence these parameters.

Perching

The percentage of cows perching increased when the stall base was completely covered with bedding, regardless of the type of stall base or bedding type. Although perching has been associated with shorter stalls and stalls with restrictive neck rails, neither impacted perching in this assessment. Curb height was associated with perching, as curb heights of 13.0 or more inches resulted in less perching, possibly due to increased proportion of weight being placed on the rear legs. Perching was also increased in summer months compared with spring months, likely due to cows attempting to dissipate heat during the summer.

Standing

Contrary to findings associated with perching, standing in stalls was not associated with bedding quantity but was associated with certain bedding types; a lower percentage of cows were standing in stalls bedded with straw, coarse sand, composted manure or no bedding compared with most other bedding types. Operations without neck rails had the lowest percentage of cows standing compared with operations with neck rails. Stall length did not impact standing. These were unexpected findings, since it was thought that less restrictive stalls (i.e., longer stalls, no neck rail) would lead to more cows standing in the stall.

Lying

A higher percentage of cows lying occurred on operations that used coarse sand as bedding compared with cows on operations that used straw, composted or dried manure, or "other" bedding types. In addition, a higher percentage of cows were lying when bedding had been changed/added within 1 to 2 days of the assessment than when bedding had been changed/added within 7 or more days of the assessment . Other features of bedding and stall management were not associated with the percentage of cows lying. Stall widths of 50 inches or more were associated with increased lying but stall length was not associated with lying. The absence of a neck rail was associated with a lower percentage of cows perching and standing and was also associated with a lower percentage of cows lying. Similarly, the absence of a brisket locator was associated with a lower percentage of cows lying. Curb height was also associated with lying, as curb heights of 13 inches or more were associated with a lower percentage of cows lying. The percentage of cows lying also decreased in summer compared with spring, which was likely due to improved dissipation of heat.

Cow comfort index

The CCI was higher for cows housed in facilities bedded with coarse sand compared with most other bedding types. The CCI was higher when bedding was level with the curb than when bedding was slightly dished out or more than 50 percent of the base was exposed. Season, which was associated with perching and lying, was also associated with the CCI, as a higher CCI was observed during the spring months.

Summary

Components of freestalls designed to keep cows comfortable, clean, and free of injury—such as neck rails and brisket locators—did not have much of an impact on hygiene, hock health, and comfort, which was unexpected. Stall base, bedding type and frequency, and bedding quality/stall condition were important for improving hygiene, hock health, and cow comfort. There also appears to be a trade off in keeping cows clean and keeping hocks healthy, as dry lots generally had dirtier cows but also had cows with much healthier hocks compared with cows housed in stalls. The findings in this report should assist in determining areas for improvement for each housing type, while also providing relevant information that may contribute to the development of new housing systems that provide optimal welfare for dairy cows.

Selected Highlights

The Dairy 2007 study marks the first time that the National Animal Health Monitoring System has studied parameters associated with cow comfort on dairy operations. A few highlights from this report follow.

Almost one-half of operations (49.2 percent) housed lactating cows primarily in a tie-stall/ stanchion facility and nearly one of three operations (32.6 percent) housed cows in freestalls. However, almost 60 percent of cows were housed on freestall operations due to the fact that a high percentage of large operations use freestalls.

Concrete was the predominant flooring type on approximately one-half of operations and for 55.6 percent of cows. Pasture was the predominant flooring type on 10.1 percent of operations and for 5.1 percent of cows. Dirt was the predominant flooring type on 5.4 percent of operations and for 20.0 percent of cows, which likely reflects the use of dry lots on large operations.

Heat abatement methods, including shade, fans, sprinklers, or misters, were provided during the summer months by more than 9 of 10 operations.

The following highlights refer only to operations that completed the facility, cow, and/or comfort assessments (see Section II, p 49).

About 8 of 10 operations used tie stalls or freestalls to house cattle. On average, stanchion barns were constructed in 1949 and were the oldest housing type. Freestall barns and other multiple-animal areas were constructed more recently than tie-stall barns. For all operations, 1976 was the average year of construction for all housing types.

A total of 69.6 percent of freestall operations housed fewer than 1.10 cows per stall at the time of the assessment. By design, tie-stall and stanchion operations housed one cow per stall.

All tie-stall and stanchion operations provided 32 inches or more of bunk space per cow. In contrast, 57.1 percent of freestall operations provided less than the minimum recommended 24 inches of bunk space per cow at the time of the assessment. At maximum cow numbers (i.e., minimum feedbunk space), 67.9 percent of freestall operations provided less than the recommended minimum of 24 inches.

Hygiene scoring was performed on 477 operations. Freestall operations accounted for 282 of these operations and provided the majority (68.3 percent) of all cows scored. Approximately twice as many cows were scored on freestall, dry lot, and other multiple-animal area operations than operations with tie stalls or stanchions. These differences in animals scored among different housing types are directly related to herd size.

There were no differences by housing type in the percentages of cows with hygiene scores of 1 (clean). A lower percentage of cows had a hygiene score of 3 (dirty) on freestall operations (10.0 percent) compared with tie-stall, stanchion, and dry lot operations (16.2, 21.4, and 22.3 percent, respectively).

Bedding type influenced hygiene scores. The lowest percentage of cows with a hygiene score of 3 were on operations that bedded stalls with coarse sand, composted manure, or dried manure (primarily freestall operations). As bedding quantity/stall condition decreased until the stall base was exposed, the percentage of cows with a hygiene score of 3 increased.

Freestall operations with stall lengths of less than 82.0 inches or 96.0 inches or more had a higher percentage of cows with a hygiene score of 1 (61.1 and 54.8 percent, respectively) compared with freestall operations with stall lengths of 86.0 to 91.9 inches (35.7 percent). The width of stalls did not have an impact on hygiene scores. The forward location of the neck rail was not associated with the percentage of cows by hygiene score.

Operations with any gutter grates had a higher percentage of cows assigned a hygiene score of 1 compared with operations without gutter grates. The presence of cow trainers was also associated with cleaner cows; 50.3 percent of cows on operations with trainers had a hygiene score of 1 compared with 37.6 percent of cows on operations without trainers. Almost twice the percentage of cows on operations that did not use trainers had a hygiene score of 3 compared with operations that used trainers (23.6 and 14.1 percent, respectively).

No differences were observed in spring (March–May) and summer (June–September) in the percentage of cows by hygiene score.

Hock scoring was performed on 477 operations; freestall operations accounted for 282 of these operations, providing the majority of all cows scored (67.9 percent). Approximately twice as many cows were scored on freestall, dry lot, and other multiple-animal area operations compared with operations that used tie stalls or stanchions. These differences in animals scored among different housing types are directly related to herd size.

Operations with dry lots and other multiple-animal areas had the highest percentage of cows assigned a hock score of 1 [no hair loss or swelling] (91.1 and 90.8 percent, respectively). Approximately three of four cows on freestall operations (76.8 percent) were assigned a hock score of 1, while tie-stall and stanchion operations had the lowest percentage of cows with a score of 1 (65.7 and 61.9 percent, respectively). Dry-lot operations had a lower percentage of cows with hock scores of 3 (swelling or skin lesion present) compared with tie-stall, stanchion, and freestall operations.

Almost 9 of 10 cows (89.5 percent) on operations that used dirt as a stall base were assigned a hock score of 1. The lowest percentage of cows assigned a hock score of 1 were on operations that used concrete, rubber mats, or mattresses as a stall base (72.8, 65.9,

and 60.6 percent, respectively). The lowest percentage of cows assigned a hock score of 3 were on operations that used dirt as a stall base (0.7 percent), while the highest percentage of cows with a score of 3 were on operations that used concrete, rubber mats, or mattresses as a stall base (5.6, 7.2, and 5.0 percent, respectively).

A higher percentage of cows bedded with fine or coarse sand, composted or dried manure, or no bedding (primarily operations with freestalls, dry lots, or other multiple-animal areas) had hock scores of 1 compared with cows bedded with straw or sawdust (primarily tie-stall and stanchion operations). Similarly, a lower percentage of cows bedded in coarse sand and composted manure had hock scores of 3 compared with cows on straw, sawdust, or "other" bedding.

As the number of days since bedding was added increased, the percentage of cows assigned a hock score of 1 increased. The percentage of cows by hock scores was associated with bedding quantity. As bedding quantity decreased until the stall base was mostly exposed, a lower percentage of cows had hock scores of 1. In addition, a higher percentage of cows had hock scores of 1 when no bedding was present than when the stall base was exposed.

The season in which assessments were made (spring or summer) did not impact hock scores.

Comfort parameters were evaluated on 485 operations, and the pens and areas evaluated housed 52,490 cows. The majority of operations (290) and cows (39,014) assessed were on freestall operations. Four comfort parameters were assessed: perching (standing with the front feet inside the stall), standing (with all feet inside the stall), lying, and the cow comfort index (the proportion of cows in contact with a stall that are lying down) [CCI].

The percentages of cows perching were similar across all bedding types. Standing in stalls was observed for a lower percentage of cows when straw, coarse sand, composted manure, or no bedding was used compared with most other bedding types. A higher percentage of cows were lying in stalls bedded with coarse sand (48.0 percent) compared with stalls bedded with straw, composted or dried manure, or "other" bedding types (33.6, 30.2, 28.5, and 30.8 percent, respectively). With the exception of composted manure, the CCI was highest for operations that bedded with coarse sand compared with all other bedding types.

The percentage of cows perching in stalls was higher on operations in which the stall base was not exposed, bedding level with curb or slightly dished out (8.2 and 10.2 percent, respectively) compared with operations in which the stall base was less than 50 percent exposed (6.0 percent). Bedding quantity/stall condition was not associated with standing or lying parameters. The CCI was higher when bedding was level with the curb (74.2 percent) compared with bedding slightly dished out or more than 50 percent of the base exposed (63.7 and 66.2 percent, respectively).

The type or presence of a neck rail did not impact the percentage of cows perching or the CCI. A lower percentage of cows were standing in the stall when no neck rail was present (4.0 percent) compared with either the presence of a stationary or moveable neck rail (9.7 and 11.9 percent, respectively). Similarly, a lower percentage of cows were lying when no neck rail was present compared with operations with stationary or moveable neck rails.

The presence of a brisket locator or the locator material did not affect the percentage of cows that were perching, standing, or the CCI. However, operations that did not have a brisket locator had a lower percentage of cows lying (32.6 percent) compared with operations that had brisket locators made of wood (41.9 percent) or PVC or other plastic pipe (46.4 percent).

Season had a significant impact on the percentage of cows perching, lying, and on the CCI. The percentage of cows perching was lower in spring (March–May) than in summer (June–September), while the percentage of cows lying and the CCI were higher in spring than in summer.

Acknowledgments

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Thank you to the NASS enumerators, State and Federal veterinary medical officers (VMOs), and animal health technicians (AHTs) who visited the operations and collected the data for the Dairy 2007 study. Their hard work and dedication to USDA's National Animal Health Monitoring System (NAHMS) were invaluable. The roles of the producers, area veterinarians in charge (AVICs), NAHMS coordinators, VMOs, AHTs, and NASS enumerators were critical in providing quality data for Dairy 2007 reports. Recognition also goes to the personnel at the Centers for Epidemiology and Animal Health for their efforts in generating and distributing valuable reports from Dairy 2007 data.

Additional biological sampling and testing were afforded by the generous contributions of collaborators for the Dairy 2007 study, including

- USDA–APHIS, National Veterinary Services Laboratories;
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- Tetracore, Inc.;
- University of British Columbia, Canada, Animal Welfare Program;
- University of California, Davis;
- University of Pennsylvania, New Bolton Center;
- University of Wisconsin, Madison; and
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All participants are to be commended, particularly the producers whose voluntary efforts made the Dairy 2007 study possible.

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Feedback

Feedback, comments, and suggestions regarding the Dairy 2007 study reports are welcomed. Please forward correspondence via email at: NAHMS@aphis.usda.gov, or you may submit feedback via online survey at: http://nahms.aphis.usda.gov (Click on "FEEDBACK on NAHMS reports.")

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Introduction

The National Animal Health Monitoring System (NAHMS) is a nonregulatory program of the Animal and Plant Health Inspection Service (APHIS), a branch of the U.S. Department of Agriculture (USDA). Designed to help meet the animal health information needs of a variety of stakeholders, NAHMS has collected data on dairy health and management practices through four previous studies.

The NAHMS 1991–92 National Dairy Heifer Evaluation Project (NDHEP) provided the dairy industry's first national information on the health and management of dairy cattle in the United States. Just months after the study's first results were released in 1993, cases of acute bovine viral diarrhea (BVD) surfaced in the United States following a 1993 outbreak in Canada. NDHEP information on producer vaccination and biosecurity practices helped officials address the risk of disease spread and target educational efforts on vaccination protocols. When an outbreak of human illness related to *Escherichia coli* O157:H7 was reported in 1993 in the Pacific Northwest, NDHEP data on the bacteria's prevalence in dairy cattle helped officials define public risks as well as research needs. This baseline picture of the industry also helped identify additional research and educational needs in various production areas, such as feed management and weaning age.

Information from the NAHMS Dairy 1996 study helped the U.S. dairy industry identify educational needs and prioritize research efforts on such timely topics as antibiotic use; Johne's disease; digital dermatitis; bovine leukosis virus (BLV); and potential foodborne pathogens, including *E. coli*, *Salmonella*, and *Campylobacter.* A total of 26 States participated in Dairy 1996.

Two major goals of the Dairy 2002 study were to describe management strategies that prevent and reduce Johne's disease and to determine management factors associated with *Mycoplasma* and *Listeria* in bulk-tank milk. The study was designed also to describe levels of participation in quality assurance programs, the incidence of digital dermatitis, animal-waste handling systems used on U.S. dairy operations, and industry changes since the NDHEP in 1991 and the Dairy 1996 study. A total of 21 States participated in Dairy 2002.

The Dairy 2007 study was conducted in 17 of the Nation's major dairy States (see map next page) and provides participants, stakeholders, and the industry as a whole with valuable information representing 79.5 percent of U.S. dairy operations and 82.5 percent of U.S. dairy cows. Phase I data were collected from 2,194 dairy operations by National Agricultural Statistics Service enumerators from January 1–31, 2007. For phase II of the Dairy 2007 study, data were collected from a subset of Phase I participants (582 operations with 30 or more dairy cows). Phase II data were collected by State and Federal veterinary medical officers (VMOs) and animal health technicians (AHTs) between February 26 and August 31, 2007.

One objective of the Dairy 2007 study was to evaluate management factors related to cow comfort and removal rates. This report provides information collected during the Dairy 2007 study about facilities and cow comfort on U.S. dairy operations.

Dairy 2007 Participating States

Information on the methods used and number of respondents in the study can be found at the end of this report.

All Dairy 2007 study reports, as well as reports from previous NAHMS dairy studies, are available online at http://nahms.aphis.usda.gov

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Study Objectives and Related Outputs

1. Describe trends in dairy cattle health and management practices
- Part II: Changes in the U.S. Dairy Cattle Industry, 1991–2007, March 2008
- Part V: Changes in Dairy Cattle Health and Management Practices in the United States, 1996–2007, July 2009

2. Evaluate management factors related to cow comfort and removal rates
- **Facility Characteristics and Cow Comfort on U.S. Dairy Operations, 2007, Interpretive Report, December 2010**

3. Describe dairy calf health and nutrition from birth to weaning and evaluate heifer disease prevention practices
- Part I: Reference of Dairy Cattle Health and Management Practices in the United States, 2007, October 2007
- Off-Site Heifer Raising on U.S. Dairy Operations, 2007, info sheet, November 2007
- Colostrum Feeding and Management on U.S. Dairy Operations, 1991–2007, info sheet, March 2008
- Part IV: Reference of Dairy Cattle Health and Management Practices in the United States, 2007, February 2009
- Calving Intervention on U.S. Dairy Operations, 2007, info sheet, February 2009
- Heifer Calf Health and Management Practices on U.S. Dairy Operations, 2007, Interpretive Report, February 2010
- Passive Transfer in Dairy Heifer Calves, 1991–2007, info sheet, March 2010

4. Estimate the prevalence of herds infected with bovine viral diarrhea virus (BVDV)
- Bovine Viral Diarrhea (BVD) Management Practices and Detection in Bulk Tank Milk in the United States, 2007, info sheet, October 2008

5. Describe current milking procedures and estimate the prevalence of contagious mastitis pathogens
- Part III: Reference of Dairy Cattle Health and Management Practices in the United States, 2007, September 2008
- Milking Procedures on U.S. Dairy Operations, 2007, info sheet, October 2008
- Prevalence of Contagious Mastitis Pathogens on U.S. Dairy Operations, 2007, info sheet, October 2008

6. Estimate the herd-level prevalence and associated costs of *Mycobacterium avium* subspecies *paratuberculosis*
- Johne's Disease on U.S. Dairies, 1991–2007, info sheet, April 2008

7. Describe current biosecurity practices and determine producer motivation for implementing or not implementing biosecurity practices
- Part I: Reference of Dairy Cattle Health and Management Practices in the United States, 2007, October 2007
- Part III: Reference of Dairy Cattle Health and Management Practices in the United States, 2007, September 2008
- Biosecurity Practices on U.S. Dairy operations, 1991–2007, Interpretive Report, May 2010

8. Determine the prevalence of specific food-safety pathogens and describe antimicrobial resistance patterns

- Antibiotic Use on U.S. Dairy Operations, 2002 and 2007, info sheet, October 2008
- Prevalence of *Salmonella* and *Listeria* in Bulk Tank Milk and In-line Filters on U.S. Dairies, 2007, info sheet, July 2009
- *Salmonella* and *Campylobacter* on U.S. Dairy Operations, 2002–07, info sheet, July 2009
- *Salmonella*, *Listeria,* and *Campylobacter* on U.S. Dairy Operations, 2007, Interpretive Report, expected winter 2011
- Prevalence of *Coxiella burnetii* on U.S. Dairy Operations, 2007, info sheet, expected winter 2011
- Prevalence of *Clostridium difficile* on U.S. Dairy Operations, 2007, info sheet, expected winter 2011

Additional information sheets

- Dairy Cattle Identification Practices in the United States, 2007, info sheet, November 2007
- Bovine Leukosis Virus (BLV) on U.S. Dairy Operations, 2007, info sheet, October 2008
- Reproduction Practices on U.S. Dairy Operations, 2007, info sheet, February 2009
- Injection Practices on U.S. Dairy Operations, 2007, info sheet, February 2009
- Methicillin-Resistant *Staphylococcus aureus* (MRSA) Isolation from Bulk Tank Milk in the United States, 2007, info sheet, November 2010

Terms Used in This Report

Brisket locator: A feature of freestalls designed to help prevent cows from lying too far forward in the stall. Brisket locators are usually constructed of wood and placed at the front of the stall bed.

Cow: Female dairy bovine that has calved at least once.

Cow average: The average value for all cows; the reported value for each operation multiplied by the number of cows on that operation is summed over all operations and divided by the number of cows on all operations. This way, results are adjusted for the number of cows on each operation. For instance, on p 13 the rolling herd average milk production per cow is multiplied by the number of cows for each operation. This product is then summed over all operations and divided by the sum of cows over all operations. The result is the rolling herd average milk production for all cows.

Cow comfort index (CCI): A measure of cow comfort calculated as the percentage of cows in contact with a stall and lying down. The recommended CCI is 85 percent or more when measured 1 hour after cows return from the morning milking. Recent research suggests that CCI is not associated with lying times and may not be the best comfort parameter to measure.

Cow density: The number of cows per stall or headlock.

Cow trainer: A tin or wire structure placed a few inches above a cow to prevent her from soiling the platform of her stall by administering a gentle electric shock if she arches her back to urinate or defecate while too far forward in the stall.

Curb: A feature of freestalls that separates the stall area from the alley. Curbs are generally constructed of concrete.

Dry-lot housing: An open dirt lot that has no vegetative cover and is used for housing cows in more arid climates.

Freestall housing: Housing consisting of resting cubicles or "beds" in which dairy cows are free to enter and leave at will.

Gutter: A channel located behind cows in tie-stall and stanchion barns to capture manure and urine.

Gutter grates: Coverings for gutters that assist in keeping the cow's tail clean while allowing manure and urine to pass through.

Heifer: Female dairy bovine that has not yet calved.

Headlocks: Self-locking stanchions along a feed alley in which multiple cows can be restrained at once.

Herd size: Herd size is based on January 1, 2007, dairy cow inventory. Small herds are those with fewer than 100 head; medium herds are those with 100 to 499 head; and large herds are those with 500 or more head.

Loose housing system: Facility that allows the cows to move around and choose among eating, drinking, standing, or lying. Freestall and dry-lot housing are common types of loose housing. A loose-housing system is in contrast to a tie-stall or stanchion operation in which cows are restrained to individual stalls.

Lunge space: The area in front or to the side of the stall bed that allows cows to move their head forward or sideways when rising.

Neck rail: A feature of freestalls usually made of pipe or cable and mounted across the top of the freestall loops. Neck rails were designed to discourage cows from moving too far forward when entering the stall and encourage cows to move backward when rising.

Operation average: The average value for all operations. A single value for each operation is summed over all operations reporting divided by the number of operations reporting. For example, operation average rolling herd average (RHA) milk production (shown on p 13) is calculated by summing reported average RHA milk production over all operations divided by the number of operations.

Other multiple-animal area: Cow housing areas such as pasture or a combination of housing types such as freestall and dry-lot housing. Refers to housing other than tie stall, stanchion, freestall, or dry lot. In some instances in this report, which will be noted, operations with dry lots were included in this category due to small sample size.

Perching: A term commonly used to describe cows that have both front feet in the stall and both back feet in the alleyway.

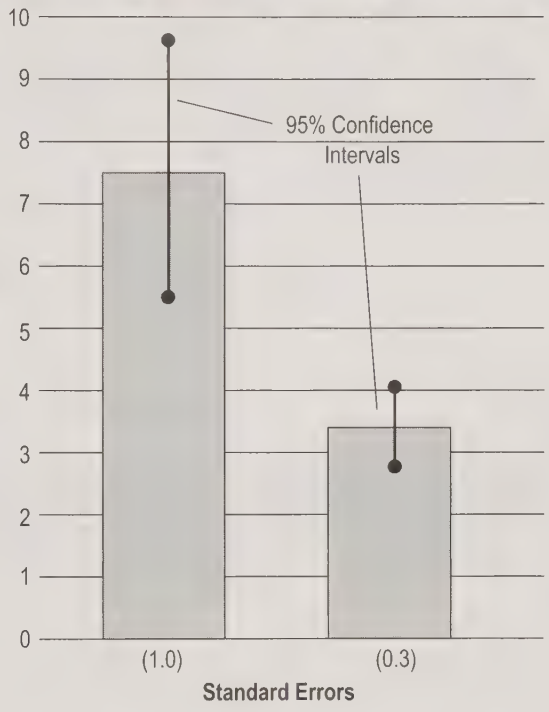
Population estimates: The estimates in this report make inference to all operations or dairy cattle in the target population (see Methodology section, p 156). Data from the operations responding to the survey are weighted to reflect their probability of selection during sampling and to account for any survey nonresponse.

Precision of population estimates: Estimates in this report are provided with a measure of precision called the standard error. A 95-percent confidence interval can be created with bounds equal to the estimate plus or minus two standard errors. If the only error is sampling error, the confidence intervals created in this manner will contain the true population mean 95 out of 100 times. In the example to the right, an estimate of 7.5 with a standard error of 1.0 results in limits of 5.5 to 9.5 (two times the standard error above and below the estimate). The second estimate of 3.4 shows a standard error of 0.3 and results in limits of 2.8 and 4.0. Alternatively, the 90-percent confidence interval would be created by multiplying the standard error by 1.65 instead of 2. Most estimates in this report are rounded to the nearest tenth. If rounded to 0, the standard error was reported (0.0). If there were no reports of the event, no standard error was reported (—). References to estimates being "higher" or "lower" than other estimates are based on the 95-percent confidence intervals not overlapping. Where noted in this report, STATA and SUDAAN were used to compare estimates and determine significance. P values less than 0.05 were considered statistically significant.

Regions:

- **West:** California, Idaho, New Mexico, Texas, and Washington
- **East:** Indiana, Iowa, Kentucky, Michigan, Minnesota, Missouri, New York, Ohio, Pennsylvania, Vermont, Virginia, and Wisconsin

Examples of a 95% Confidence Interval



Sample profile: Information that describes characteristics of the operations from which Dairy 2007 data were collected. See Appendix I, p 164.

Season: For this report, spring included the months of March, April, and May. Summer included the months of June, July, August, and September.

Space allotment: A measure of space for cows. Commonly used measures include square feet for cows in pens and inches of bunk space per cow.

Stall base: The floor of the stall usually comprised of permanent or semipermanent materials upon which bedding is usually added. Common materials used for stall bases include dirt, concrete, rubber mats, and mattresses.

Stall partition (loop): A wooden or steel structure that separates adjacent resting spaces. Used in tie-stall, stanchion, and freestall housing systems.

Stanchion housing: Housing in which a cow is restrained to a particular stall in a device with two rails that close around the cow's neck after she enters a stall. Cows are not able to enter and leave the stalls at will.

Tie-stall housing: Housing in which a cow is restrained to a particular stall by a neck collar attached to the stall by a chain. Cows are not able to enter and leave the stalls at will.

Usual calving area: An area designated specifically for calving separate from housing for lactating cows. Tie stalls and stanchions were not considered usual calving areas for the purpose of this report.

Section I: Population Estimates

Note: Unless otherwise specified, estimates in Section I represent operations with any dairy cows.

A. Operation and Facility Characteristics

1. Operation types

Producers were asked to identify their operations by type: conventional, grazing, combination, or organic. On conventional operations, the majority of forage was harvested and "delivered" to cows; on grazing operations, the majority of forage was "harvested" by cows; combination operations used both conventional and grazing practices; and organic operations met USDA organic standards.

The majority of dairy operations (63.9 percent) were conventional operations, and the majority of dairy cows (82.2 percent) were on these operations. Grazing and organic operations accounted for only 3.1 and 1.7 percent of operations, respectively, and together represented less than 3.0 percent of dairy cows.

a. Percentage of operations (and percentage of cows on these operations), by operation type

Operation Type	Percent Operations	Standard Error	Percent Cows*	Standard Error
Conventional	63.9	(1.4)	82.2	(0.9)
Grazing	3.1	(0.6)	1.7	(0.4)
Combination of conventional and grazing	31.1	(1.3)	14.9	(0.8)
Organic	1.7	(0.4)	1.2	(0.3)
Other	0.2	(0.1)	0.0	(0.0)
Total	100.0		100.0	

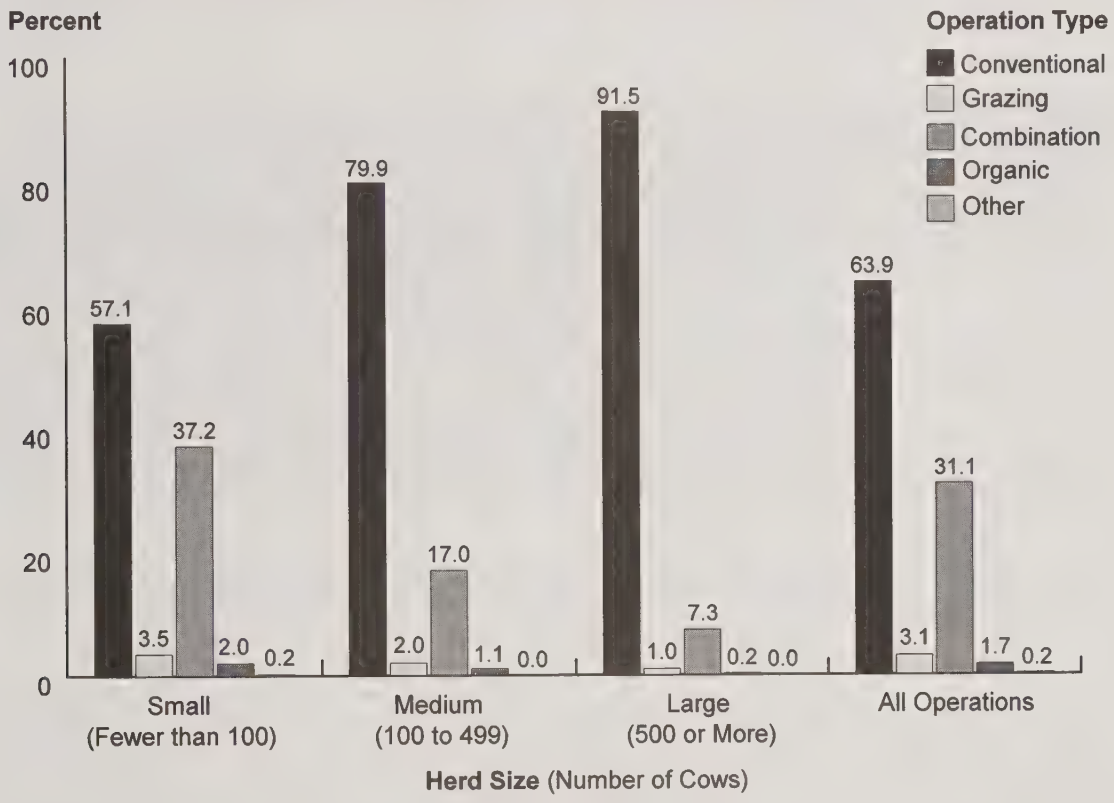
*As a percentage of January 1, 2007, cow inventory.

The percentage of conventional dairy operations increased as herd size increased, while the percentage of combination operations decreased as herd size increased.

b. Percentage of operations by operation type and by herd size

	Percent Operations					
	Herd Size (Number of Dairy Cows)					
	Small (Fewer than 100)		Medium (100–499)		Large (500 or More)	
Operation Type	Percent	Std. Error	Percent	Std. Error	Percent	Std. Error
Conventional	57.1	(1.8)	79.9	(1.7)	91.5	(1.4)
Grazing	3.5	(0.7)	2.0	(0.7)	1.0	(0.4)
Combination of conventional and grazing	37.2	(1.7)	17.0	(1.6)	7.3	(1.3)
Organic	2.0	(0.6)	1.1	(0.3)	0.2	(0.1)
Other	0.2	(0.1)	0.0	(0.0)	0.0	(0.0)
Total	100.0		100.0		100.0	

Percentage of Operations by Operation Type and by Herd Size



The West region had a higher percentage of conventional operations than the East region (72.4 and 63.2 percent, respectively). Conversely, the East region had a higher percentage of combination operations than the West region (32.4 and 15.8 percent, respectively). The percentages of grazing and organic operations were similar in the West and East regions.

c. Percentage of operations by operation type and by region

	Percent Operations			
	Region			
	West		East	
Operation Type	Percent	Std. Error	Percent	Std. Error
Conventional	72.4	(2.9)	63.2	(1.4)
Grazing	8.0	(2.4)	2.7	(0.6)
Combination	15.8	(2.0)	32.4	(1.4)
Organic	3.8	(1.3)	1.5	(0.4)
Other	0.0	(0.0)	0.2	(0.1)
Total	100.0		100.0	

Conventional operations and the dairy cows on these operations had the highest rolling herd average (RHA) milk production (20,253 and 22,182 lb/cow, respectively). RHA milk production was similar for grazing, organic, and other operations.

d. Operation average (and cow average) RHA* milk production (lb/cow), by operation type

Operation Type	Operation Average (lb/cow)	Std. Error	Cow Average (lb/cow)	Std. Error
Conventional	20,253	(135)	22,182	(126)
Grazing	15,146	(608)	15,903	(457)
Combination	17,587	(213)	18,696	(217)
Organic	15,266	(714)	16,369	(728)
Other	15,760	(1,520)	14,757	(1,709)
All	19,175	(112)	21,483	(115)

*Average milk production per cow during a 12-month period.

Photo courtesy Dr. Jason Lombard

2. Housing facilities

The majority of operations across herd sizes used primarily individual pens/hutches to house preweaned heifers. The percentage of operations that used tie stall/stanchions or multiple-animal inside areas to house preweaned heifers decreased as herd size increased. More than one-third of large operations (35.4 percent) did not raise preweaned heifers on the operation.

a. Percentage of operations by primary housing facility/outside area used for *preweaned heifers* during 2006, and by herd size

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		Medium (100–499)		Large (500 or More)		All Operations	
Housing Type	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Tie stall/ stanchion	10.1	(1.1)	6.9	(1.3)	0.4	(0.2)	8.9	(0.8)
Freestall	2.8	(0.6)	3.0	(0.7)	1.0	(0.5)	2.7	(0.5)
Individual pen/ hutch	65.9	(1.7)	75.9	(2.0)	62.5	(2.9)	67.9	(1.3)
Dry lot/multiple-animal outside area	0.6	(0.3)	0.5	(0.2)	0.0	(0.0)	0.6	(0.2)
Multiple-animal inside area	17.8	(1.4)	5.8	(1.0)	0.7	(0.4)	14.2	(1.1)
Pasture	0.6	(0.2)	0.8	(0.6)	0.0	(0.0)	0.6	(0.2)
Not housed on operation	1.7	(0.5)	7.1	(1.2)	35.4	(2.9)	4.7	(0.5)
Other	0.5	(0.2)	0.0	(0.0)	0.0	(0.0)	0.4	(0.2)
Total	100.0		100.0		100.0		100.0	

Regional differences were observed in primary housing for preweaned heifers. A lower percentage of operations in the West region than in the East region housed preweaned heifers in tie stalls or stanchions (1.4 and 9.5 percent, respectively). Multiple-animal inside areas were used by more than twice the percentage of operations in the East region than in the West region (14.8 and 6.4 percent, respectively). More than one of five operations in the West region (21.9 percent) did not house preweaned heifers compared with 3.3 percent in the East region.

b. Percentage of operations by primary housing facility/outside area used for *preweaned heifers* during 2006, and by region

	Percent Operations			
	Region			
	West		East	
Housing Type	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Tie stall/stanchion	1.4	(0.6)	9.5	(0.9)
Freestall	3.3	(1.1)	2.7	(0.5)
Individual pen/hutch	64.0	(3.0)	68.3	(1.4)
Dry lot/multiple-animal outside area	1.2	(0.6)	0.5	(0.2)
Multiple-animal inside area	6.4	(1.8)	14.8	(1.2)
Pasture	1.8	(1.7)	0.5	(0.1)
Not housed on operation	21.9	(2.4)	3.3	(0.5)
Other	0.0	(0.0)	0.4	(0.2)
Total	100.0		100.0	

About one-third of operations housed weaned heifers primarily in a multiple-animal inside area (34.6 percent), while approximately one-fourth housed weaned heifers in a dry lot/multiple-animal outside area (22.9 percent). Small operations primarily housed weaned heifers in dry lots/multiple-animal outside and inside areas (22.3 and 37.8 percent, respectively). More than 4 of 10 large operations primarily housed weaned heifers in a dry lot/multiple-animal outside area (43.2 percent). The percentage of operations that did not house weaned heifers increased as herd size increased; nearly one-fourth of large operations did not house weaned heifers (24.8 percent).

c. Percentage of operations by primary housing facility/outside area used for *weaned heifers*, and by herd size

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		Medium (100–499)		Large (500 or More)		All Operations	
Housing Type	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Tie stall/ stanchion	6.7	(1.0)	4.6	(1.1)	0.5	(0.2)	5.9	(0.7)
Freestall	10.2	(1.1)	18.2	(1.8)	13.7	(2.2)	12.1	(0.9)
Individual pen/hutch	6.3	(0.9)	3.0	(0.9)	1.9	(0.8)	5.3	(0.7)
Dry lot/multiple-animal outside area	22.3	(1.4)	19.8	(1.8)	43.2	(2.7)	22.9	(1.1)
Multiple-animal inside area	37.8	(1.8)	29.8	(2.0)	10.1	(1.9)	34.6	(1.4)
Pasture	11.7	(1.1)	9.4	(1.2)	4.6	(1.0)	10.8	(0.9)
Not housed on operation	4.6	(0.7)	13.8	(1.6)	24.8	(2.4)	7.7	(0.7)
Other	0.4	(0.2)	1.4	(0.7)	1.2	(0.7)	0.7	(0.2)
Total	100.0		100.0		100.0		100.0	

Almost one-half of operations in the West region (46.2 percent) housed weaned heifers primarily in a dry lot/multiple-animal outside area compared with almost one-fifth of operations in the East region (20.9 percent). Approximately one of eight operations in the West region (12.1 percent) housed weaned heifers in multiple-animal inside areas compared with approximately one of three operations in the East region (36.4 percent).

d. Percentage of operations by primary housing facility/outside area used for *weaned heifers*, and by region

	Percent Operations			
	Region			
	West		East	
Housing Type	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Tie stall/stanchion	0.4	(0.2)	6.4	(0.8)
Freestall	12.7	(2.0)	12.1	(0.9)
Individual pen/hutch	3.3	(1.2)	5.5	(0.7)
Dry lot/multiple-animal outside area	46.2	(2.9)	20.9	(1.2)
Multiple-animal inside area	12.1	(1.9)	36.4	(1.5)
Pasture	12.7	(2.3)	10.7	(0.9)
Not housed on operation	12.1	(1.9)	7.3	(0.7)
Other	0.5	(0.3)	0.7	(0.2)
Total	100.0		100.0	

Almost one-half of operations (49.2 percent) housed lactating cows primarily in a tie-stall/stanchion facility. Nearly one of three operations (32.6 percent) housed cows in freestalls. Use of tie-stall/stanchion facilities decreased from 63.0 percent of small operations to 0.7 percent of large operations. Alternatively, a higher percentage of medium and large operations housed lactating cows in freestalls (67.5 and 72.6 percent, respectively) compared with small operations (19.0 percent). Almost one-fourth of large operations (24.2 percent) housed lactating cows primarily in dry lots/multiple-animal outside areas.

e. Percentage of operations by primary housing facility/outside area used for *lactating cows*, and by herd size

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		Medium (100–499)		Large (500 or More)		All Operations	
Housing Type	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Tie stall/ stanchion	63.0	(1.6)	15.7	(1.9)	0.7	(0.3)	49.2	(1.3)
Freestall	19.0	(1.3)	67.5	(2.1)	72.6	(2.3)	32.6	(1.1)
Individual pen	0.1	(0.0)	0.3	(0.2)	0.2	(0.1)	0.1	(0.1)
Dry lot/multiple-animal outside area	3.4	(0.6)	4.1	(0.7)	24.2	(2.3)	4.6	(0.5)
Multiple-animal inside area	3.5	(0.7)	3.3	(0.7)	0.8	(0.5)	3.4	(0.6)
Pasture	10.8	(1.1)	8.8	(1.2)	1.0	(0.3)	9.9	(0.8)
Other	0.2	(0.1)	0.3	(0.2)	0.5	(0.4)	0.2	(0.1)
Total	100.0		100.0		100.0		100.0	

Almost one-half of operations in the West region (49.7 percent) housed lactating cows primarily in freestalls; 29.8 percent of operations housed cows in dry lot/multiple-animal outside areas and 15.0 percent housed cows on pasture. The majority of operations in the East region (53.1 percent) housed lactating cows primarily in tie stalls/stanchions. A lower percentage of operations in the East region housed cows in freestalls compared with operations in the West region (31.2 and 49.7 percent, respectively). Pasture was the primary housing for lactating cows on about 1 of 10 operations in the East region (9.4 percent).

f. Percentage of operations by primary housing facility/outside area used for *lactating cows*, and by region

	Percent Operations			
	Region			
	West		East	
Housing Type	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Tie stall/stanchion	1.3	(0.5)	53.1	(1.4)
Freestall	49.7	(2.9)	31.2	(1.1)
Individual pen	0.8	(0.5)	0.1	(0.0)
Dry lot/multiple-animal outside area	29.8	(2.6)	2.6	(0.5)
Multiple-animal inside area	2.6	(0.9)	3.4	(0.6)
Pasture	15.0	(2.7)	9.4	(0.9)
Other	0.8	(0.5)	0.2	(0.1)
Total	100.0		100.0	

The single highest percentage of small operations kept dry cows in tie-stall/stanchion housing (30.6 percent), followed by pasture, freestall housing, and dry lot/multiple-animal outside area. More than one-third of medium operations (35.6 percent) housed dry cows in freestall housing. More than 40 percent of large operations used either freestalls or dry lot/multiple-animal outside areas. Overall, about 20 percent of operations housed dry cows in tie stall/stanchion, freestalls, dry lot/multiple-animal outside area, or pasture.

g. Percentage of operations by primary housing facility/outside area used for *dry cows* during 2006, and by herd size

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		Medium (100–499)		Large (500 or More)		All Operations	
Housing Type	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Tie stall/ stanchion	30.6	(1.7)	5.0	(1.1)	0.4	(0.2)	23.3	(1.3)
Freestall	17.5	(1.3)	35.6	(2.2)	40.9	(2.5)	22.8	(1.1)
Individual pen/ hutch	0.9	(0.3)	0.9	(0.5)	1.3	(0.7)	1.0	(0.3)
Dry lot/multiple-animal outside area	16.7	(1.3)	19.1	(1.7)	45.4	(2.6)	18.7	(1.0)
Multiple-animal inside area	12.6	(1.2)	16.4	(1.7)	3.6	(0.9)	12.9	(0.9)
Pasture	21.1	(1.4)	21.6	(1.8)	7.2	(1.3)	20.5	(1.1)
Not housed on operation	0.1	(0.1)	0.4	(0.2)	0.4	(0.2)	0.2	(0.1)
Other	0.5	(0.2)	1.0	(0.5)	0.8	(0.5)	0.6	(0.2)
Total	100.0		100.0		100.0		100.0	

The most noticeable regional difference in housing for dry cows was that a higher percentage of operations in the West region than in the East region used a dry lot/multiple-animal outside area (48.1 and 16.3 percent, respectively). Tie stalls/stanchions and multiple-animal inside areas were used by a higher percentage of operations in the East region than in the West region (25.2 and 0.5 percent, respectively).

h. Percentage of operations by primary housing facility/outside area used for *dry cows* during 2006, and by region

	Percent Operations			
	Region			
	West		East	
Housing Type	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Tie stall/stanchion	0.5	(0.2)	25.2	(1.4)
Freestall	23.3	(2.5)	22.7	(1.2)
Individual pen/hutch	1.5	(0.6)	0.9	(0.3)
Dry lot/multiple-animal outside area	48.1	(2.9)	16.3	(1.1)
Multiple-animal inside area	5.0	(1.4)	13.6	(1.0)
Pasture	20.1	(2.7)	20.5	(1.2)
Not housed on operation	0.0	(0.0)	0.2	(0.1)
Other	1.5	(0.7)	0.6	(0.2)
Total	100.0		100.0	

About two-thirds of preweaned heifers (68.2 percent) were housed in individual pens; 19.8 percent of preweaned heifers were not housed on the operation. The majority of weaned heifers were housed in dry lot/multiple-animal outside or inside areas (37.5 and 24.6 percent, respectively). Almost 6 of 10 lactating cows (56.4 percent) were in freestall housing, while approximately 2 of 10 lactating cows were housed in tie stall/stanchion or dry lot/multiple-animal outside areas. About 3 of 10 dry cows were housed in a freestall or dry lot/multiple-animal outside area.

i. Percentage of cattle by primary housing facility/outside area used during 2006, and by cattle class

Percent Cattle

	Cattle Class							
	Preweaned Heifers[1]		Weaned Heifers[2]		Lactating Cows[3]		Dry Cows[3] (Nonlactating)	
Housing Type	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Tie stall/ stanchion	3.6	(0.4)	2.6	(0.3)	18.3	(0.6)	7.8	(0.5)
Freestall	2.1	(0.5)	15.1	(1.2)	56.4	(1.4)	31.9	(1.3)
Individual pen	68.2	(1.5)	3.1	(0.5)	0.3	(0.1)	0.9	(0.2)
Dry lot/multiple-animal outside area	0.3	(0.1)	37.5	(1.5)	18.3	(1.3)	36.9	(1.4)
Multiple-animal inside area	5.7	(0.5)	24.6	(1.2)	1.6	(0.3)	8.9	(0.7)
Pasture	0.2	(0.1)	6.8	(0.6)	4.8	(0.4)	12.5	(0.7)
Not housed	19.8	(1.5)	9.6	(1.0)	NA		0.4	(0.2)
Other	0.1	(0.0)	0.7	(0.2)	0.3	(0.2)	0.7	(0.3)
Total	100.0		100.0		100.0		100.0	

[1]As a percentage of heifer calves born during 2006.
[2]As a percentage of January 1, 2007, heifer inventory.
[3]As a percentage of January 1, 2007, cow inventory.

3. Freestall barn configurations

About 8 of 10 large and medium operations housed lactating cows in freestall barns (83.2 and 81.9 percent, respectively), compared with about 3 of 10 small operations (27.2 percent). Less than one-half of all operations (44.3 percent) housed cows in freestall barns.

a. Percentage of operations* that housed lactating cows in freestall barns

Percent Operations

Herd Size (Number of Cows)

Small (Fewer than 100)		Medium (100–499)		Large (500 or More)		All Operations	
Percent	Std. Error	Percent	Std. Error	Percent	Std. Error	Percent	Std. Error
27.2	(3.0)	81.9	(3.2)	83.2	(4.2)	44.3	(2.5)

*Operations with 30 or more dairy cows.

The type of freestall barn affects ventilation, feedbunk space, and square footage per cow. Freestall barns are usually described by the number of stall rows along a feed line. Two- and four-row barns require less air movement to properly ventilate and provide more feedbunk space and square footage per cow than three- or six-row barns (Smith et al., 2001). For the 44.3 percent of operations that used freestall barns to house lactating cows, two-row freestall barns were the predominant setup on small and large operations (48.1 and 49.5 percent, respectively). Only 1.1 percent of small operations used six-row barns to house lactating cows, compared with 17.9 percent of medium and 19.8 percent of large operations.

b. For operations that used freestall barns to house lactating cows, percentage of operations* by type of barn setup that housed the majority of cows, and by herd size

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		Medium (100–499)		Large (500 or More)		All Operations	
Freestall Barn Setup	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Two-row	48.1	(6.6)	19.5	(3.5)	49.5	(5.3)	35.2	(3.4)
Three-row	20.7	(5.7)	22.2	(3.8)	8.3	(3.3)	19.9	(3.0)
Four-row	22.7	(5.0)	31.7	(4.4)	22.2	(4.8)	26.7	(3.0)
Six-row	1.1	(0.8)	17.9	(3.7)	19.8	(3.4)	11.0	(1.9)
Other	7.4	(3.7)	8.7	(2.6)	0.2	(0.1)	7.2	(2.0)
Total	100.0		100.0		100.0		100.0	

*Operations with 30 or more dairy cows.

4. Milking facilities

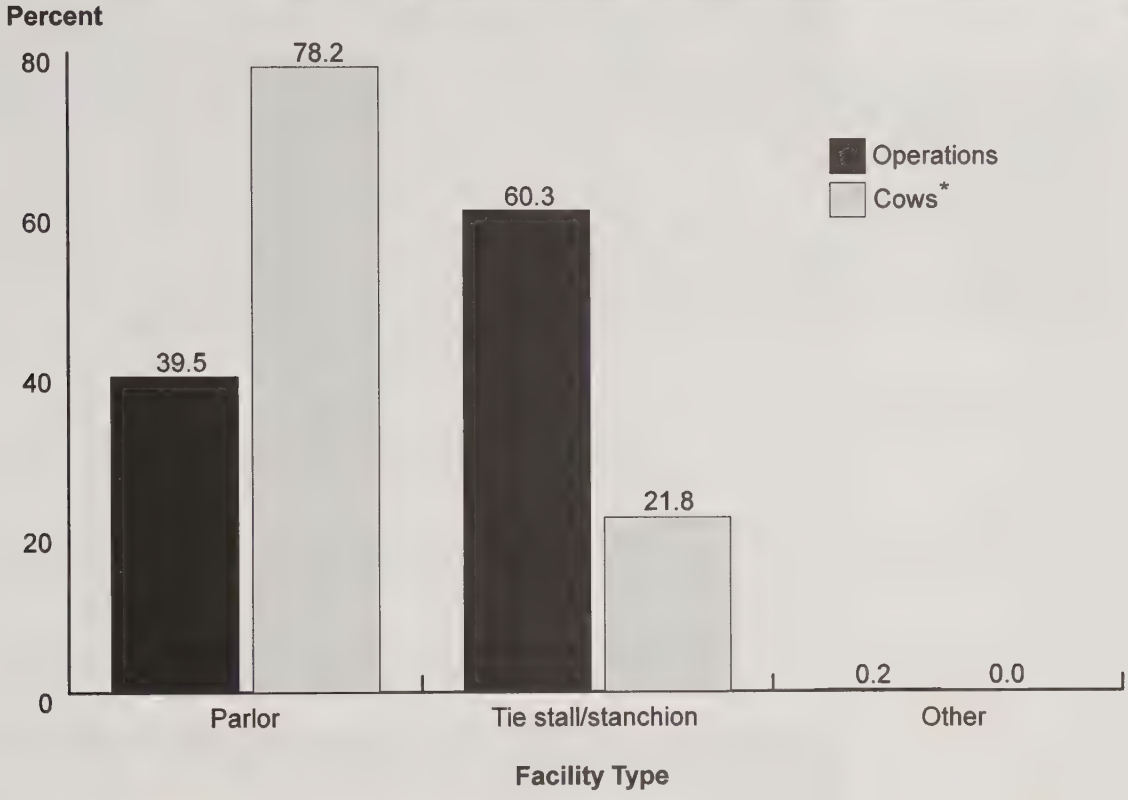
The majority of operations (60.3 percent) had a tie-stall or stanchion milking facility. Although only 39.5 percent of operations used parlors, 78.2 percent of cows were on operations that milked in parlors.

a. Percentage of operations (and percentage of cows on these operations) by primary milking facility used

Facility Type	Percent Operations	Std. Error	Percent Cows*	Std. Error
Parlor	39.5	(1.0)	78.2	(0.6)
Tie stall/stanchion	60.3	(1.0)	21.8	(0.6)
Other	0.2	(0.1)	0.0	(0.0)
Total	100.0		100.0	

*As a percentage of January 1, 2007, cow inventory.

Percentage of Operations (and Percentage of Cows on These Operations) by Primary Milking Facility Used



*As a percentage of January 1, 2007, cow inventory.

Herringbone and parallel parlors were the two most common parlor types. Over one-half of operations that primarily used parlors (54.4 percent) used a herringbone parlor, and these operations accounted for 48.7 percent of cows. Approximately one-fifth of operations (19.7 percent) used a parallel parlor for milking, and 30.6 percent of cows were on these operations.

b. For operations that primarily used a parlor milking facility, percentage of operations (and percentage of cows on these operations) by parlor type

Parlor Type	Percent Operations	Std. Error	Percent Cows	Std. Error
Side-opening (tandem)	6.6	(0.9)	3.7	(0.7)
Herringbone (fishbone)	54.4	(1.8)	48.7	(1.9)
Parallel (side-by-side)	19.7	(1.3)	30.6	(1.7)
Parabone (herringbone-parallel hybrid)	3.8	(0.6)	3.8	(0.6)
Swing	2.2	(0.6)	0.8	(0.2)
Rotary (carousel)	1.1	(0.3)	5.2	(1.3)
Flat barn	9.9	(1.2)	6.2	(0.8)
Other	2.3	(0.6)	1.0	(0.3)
Total	100.0		100.0	

Photo courtesy of Dr. Jason Lombard

B. General Management

Note: Unless otherwise specified, estimates in the following tables represent operations with 30 or more dairy cows.

1. Primary outside access areas

On the majority of operations (50.9 percent) lactating cows had routine access to pasture during summer. No outside access was allowed on 13.1 percent of operations in summer. In winter, lactating cows had access to a concrete alleyway or pen, dry lot, or allowed no outside access on 35.0, 28.9, and 25.2 percent of operations, respectively.

a. Percentage of operations by primary outside area that *lactating* cows had routine access to during summer and winter

	Percent Operations			
	Summer		Winter	
Primary Outside Area	Percent	Std. Error	Percent	Std. Error
Pasture	50.9	(2.7)	9.4	(1.5)
Concrete alleyway or pen	12.8	(1.6)	35.0	(2.8)
Dry lot	20.8	(2.2)	28.9	(2.7)
Other	2.4	(0.8)	1.5	(0.6)
None	13.1	(1.7)	25.2	(2.3)
Total	100.0		100.0	

During summer, 39.5 percent of lactating cows were on operations in which the primary outside area was a dry lot; 22.3 percent were on operations in which the primary outside area was pasture; and 19.0 percent were on operations with no outside access. In winter, similar percentages of lactating cows were on operations in which primary outside access was a concrete alleyway or pen, dry lot, or allowed no outside access (32.3, 32.7, and 29.7 percent, respectively).

b. Percentage of cows by primary outside area that *lactating* cows had routine access to during summer and winter*

	Percent Cows			
	Summer		Winter	
Primary Outside Area	Percent	Std. Error	Percent	Std. Error
Pasture	22.3	(1.6)	4.4	(0.7)
Concrete alleyway or pen	16.5	(2.1)	32.3	(3.3)
Dry lot	39.5	(3.0)	32.7	(3.5)
Other	2.7	(1.4)	0.9	(0.3)
None	19.0	(2.0)	29.7	(2.9)
Total	100.0		100.0	

*It was presumed that all lactating cows had access to the operation's primary outside area.

Dry cows had access to pasture on 67.2 percent of operations during summer and on 18.4 percent during winter. Dry cows had no outside access on 6.5 percent of operations during the summer and on 18.5 percent during winter.

c. Percentage of operations by primary outside area that *dry* cows had routine access to during summer and winter

	Percent Operations			
	Summer		Winter	
Primary Outside Area	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Pasture	67.2	(2.5)	18.4	(2.2)
Concrete alleyway or pen	5.7	(1.1)	24.1	(2.4)
Dry lot	18.5	(2.0)	34.2	(2.7)
Other	2.1	(0.8)	4.8	(1.3)
None	6.5	(1.2)	18.5	(2.1)
Total	100.0		100.0	

The majority of dry cows were on operations in which pasture or dry lot were the primary outside access areas during summer (38.5 and 41.9 percent of cows, respectively). Dry lot was the most common outside access area for dry cows in winter (43.5 percent of cows).

d. Percentage of cow inventory by primary outside area that *dry* cows had routine access to during summer and winter*

	Percent Cows			
	Summer		Winter	
Primary Outside Area	Percent	Std. Error	Percent	Std. Error
Pasture	38.5	(2.4)	11.9	(1.5)
Concrete alleyway or pen	7.3	(1.3)	19.3	(2.3)
Dry lot	41.9	(2.6)	43.5	(3.2)
Other	1.7	(0.5)	3.4	(0.8)
None	10.6	(1.7)	21.9	(2.5)
Total	100.0		100.0	

*It was presumed that all dry cows had access to the operation's primary outside area.

2. Flooring type

Flooring surfaces are important to cow health and longevity. When given an option, cows select flooring that compresses and provides cushion, such as rubber mats, pasture, or dirt. Concrete flooring is associated with increased lameness, injuries, and decreased expression of estrus. On approximately one-half of operations (51.1 percent)—representing 55.6 percent of cows—flooring for lactating cows was predominantly concrete. Pasture was the predominant flooring on 10.1 percent of operations and for 5.1 percent of cows. Dirt was the predominant flooring on 5.4 percent of operations, representing 20.0 percent of cows, which probably reflects the use of dry lots on large operations.

a. Percentage of operations (and percentage of cows on these operations) by predominant flooring type lactating cows stood or walked on when not being milked

Flooring Type	Percent Operations	Std. Error	Percent Cows	Std. Error
Concrete–grooved/textured	34.3	(2.4)	48.7	(3.5)
Concrete–slatted	1.3	(0.5)	1.1	(0.5)
Concrete–smooth	15.5	(2.3)	5.8	(0.8)
Rubber mats over concrete	22.9	(2.5)	13.9	(2.2)
Pasture	10.1	(1.7)	5.1	(0.9)
Dirt	5.4	(1.1)	20.0	(3.5)
Other	10.5	(1.8)	5.4	(1.1)
Total	100.0		100.0	

For operations with concrete flooring, the use of rubber belting or a similar material in cow areas reduces the amount of time cows spend on concrete and may decrease lameness and injuries and increase time spent at the feedbunk. Rubber belting was present on 21.2 percent of operations and was accessible to 44.4 percent of cows.

b. For operations that used parlors and on which concrete was the predominant flooring type, percentage of operations (and percentage of cows on these operations) that had rubber belting or similar flooring, by location of rubber belting

Location of Belting	Percent Operations	Std. Error	Percent Cows	Std. Error
Immediately in front of feedbunk	11.9	(2.3)	29.2	(5.1)
Walkway to parlor	6.2	(1.4)	18.9	(4.7)
Holding pen	8.1	(1.9)	14.2	(3.1)
Other	7.5	(1.7)	11.1	(1.8)
Any	21.2	(2.8)	44.4	(4.8)

3. Surface moisture

Wet flooring can be detrimental to hoof health. Cows on wet surfaces have increased hoof horn moisture and are more prone to infectious hoof diseases. The ground or flooring surface for lactating cows was usually dry on 60.3 percent of operations during summer and 49.5 percent in winter. Lactating cows usually stood in water or slurry on less than 1 percent of operations (0.6 percent).

Percentage of operations by category that best characterizes the surface moisture of the ground or flooring that lactating cows stood on most of the time during summer and winter

	Percent Operations			
	Summer		Winter	
Flooring Surface Moisture	Percent	Std. Error	Percent	Std. Error
Usually dry	60.3	(2.7)	49.5	(2.6)
Wet about half the time	22.8	(2.4)	21.8	(2.2)
Almost always wet, but no standing water	16.3	(1.7)	28.1	(2.1)
Usually standing water or slurry	0.6	(0.3)	0.6	(0.3)
Total	100.0		100.0	

4. Heat abatement

Heat has many harmful effects on dairy cattle, including decreased feed intake and milk production, reduced estrous behavior, altered formation and ovulation of follicles, and increased susceptibility to mastitis. Providing cows with shade, water sprinklers, or increased air circulation is important during summer in almost all areas of the United States. A combination of sprinklers and fans is the most common recommendation for keeping cows cool. For medium and small operations, fans were the most common method of heat abatement (74.3 and 77.7 of operations, respectively), while similar percentages of large operations provided shade, sprinklers or misters, or fans (55.6, 61.6, and 61.0 percent, respectively). Overall, 94.0 percent of operations provided some form of heat abatement for lactating cows.

a. Percentage of operations by method used to provide heat abatement for *lactating* cows during summer, and by herd size

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		Medium (100–499)		Large (500 or More)		All Operations	
Method	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Shade (other than inside building)	49.2	(3.8)	28.7	(3.4)	55.6	(5.6)	44.5	(2.8)
Sprinklers or misters	12.0	(2.4)	32.9	(3.7)	61.6	(5.8)	20.3	(1.9)
Fans	74.3	(3.2)	77.7	(3.3)	61.0	(5.3)	74.3	(2.4)
Tunnel ventilation	28.3	(3.6)	12.7	(3.0)	3.8	(2.2)	22.9	(2.6)
Other	4.9	(1.8)	6.1	(2.3)	2.5	(1.6)	5.0	(1.3)
Any	96.3	(1.2)	89.1	(2.7)	88.5	(3.7)	94.0	(1.1)

Regional differences were observed in heat abatement methods used for lactating cows. A higher percentage of operations in the West region used sprinklers or misters (42.1 percent) compared with operations in the East region (18.2 percent). Alternatively, a higher percentage of operations in the East region used fans, tunnel ventilation, or any heat abatement method compared with operations in the West region.

b. Percentage of operations by method used to provide heat abatement for *lactating cows* during summer, and by region

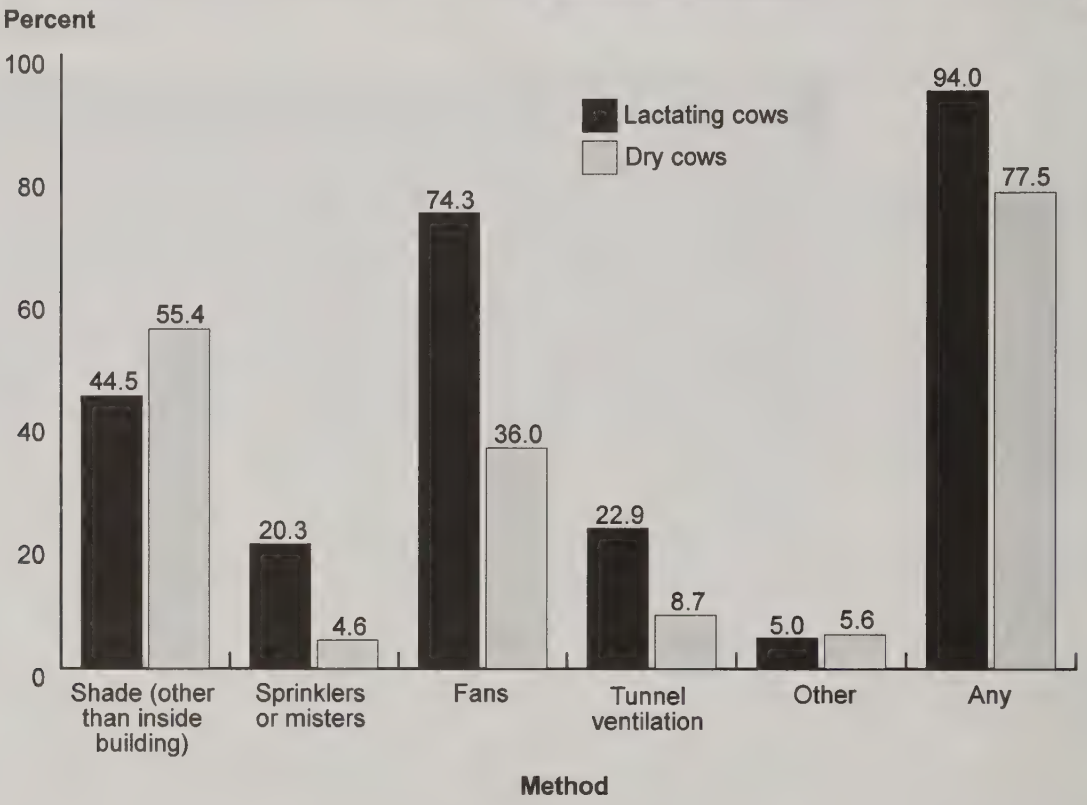
	Percent Operations			
	Region			
	West		East	
Method	Percent	Std. Error	Percent	Std. Error
Shade (other than inside building)	56.3	(5.3)	43.4	(3.1)
Sprinklers or misters	42.1	(4.7)	18.2	(2.1)
Fans	37.0	(4.5)	77.9	(2.6)
Tunnel ventilation	1.2	(0.9)	25.0	(2.8)
Other	5.3	(1.9)	5.0	(1.5)
Any	68.2	(5.0)	96.5	(1.1)

Shade and fans were the most common heat abatement methods used for dry cows on 55.4 and 36.0 percent of operations, respectively. More than three of four operations (77.5 percent) provided some method of heat abatement for dry cows.

c. Percentage of operations by method used to provide heat abatement for *dry cows* during summer, and by herd size

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100–499)		**Large** (500 or More)		**All Operations**	
Method	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Shade (other than inside building)	61.0	(3.6)	41.0	(3.9)	49.8	(5.4)	55.4	(2.7)
Sprinklers or misters	3.8	(1.6)	3.8	(1.7)	16.2	(4.5)	4.6	(1.2)
Fans	36.2	(3.8)	37.8	(4.0)	27.2	(4.3)	36.0	(2.8)
Tunnel ventilation	11.8	(2.7)	1.7	(0.9)	2.0	(1.3)	8.7	(1.9)
Other	6.3	(2.0)	4.7	(2.1)	1.8	(1.6)	5.6	(1.5)
Any	81.4	(2.8)	68.9	(3.9)	69.2	(5.9)	77.5	(2.2)

Percentage of Operations by Method Used to Provide Heat Abatement for Lactating and Dry Cows During Summer



A higher percentage of operations in the East region provided fans, tunnel ventilation, or any heat abatement method for dry cows compared with operations in the West region.

d. Percentage of operations by method used to provide heat abatement for *dry cows* during summer, and by region

	Percent Operations			
	Region			
	West		East	
Method	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Shade (other than inside building)	50.2	(5.1)	55.9	(2.9)
Sprinklers or misters	7.9	(3.2)	4.3	(1.3)
Fans	6.3	(2.0)	38.9	(3.1)
Tunnel ventilation	0.8	(0.8)	9.4	(2.1)
Other	3.0	(1.6)	5.9	(1.6)
Any	53.4	(5.1)	79.9	(2.4)

5. Calving areas

Ideally, calving areas are clean, dry, quiet, and provide enough room for a cow to comfortably lie down and deliver a calf. The majority of operations (70.0 percent) used a multiple-animal calving area/pen. A lower percentage of small operations (65.6 percent) than medium operations (79.8 percent) used a multiple-animal calving area. Approximately one-fourth of operations used an individual calving area that was either cleaned between each calving or cleaned after two or more calvings (25.5 and 26.2 percent, respectively). A higher percentage of small operations (30.6 percent) used an individual-animal pen that was cleaned between each calving compared with medium and large operations (14.6 and 13.5 percent, respectively).

a. Percentage of operations by area usually used for calving, and by herd size

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		Medium (100–499)		Large (500 or More)		All Operations	
Calving Area	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Multiple-animal area/pen	65.6	(3.5)	79.8	(3.5)	78.5	(4.3)	70.0	(2.6)
Individual animal area/pen cleaned between each calving	30.6	(3.4)	14.6	(3.3)	13.5	(3.9)	25.5	(2.5)
Individual animal area/pen cleaned after two or more calvings	25.4	(3.3)	27.4	(3.7)	30.3	(5.6)	26.2	(2.5)
Other	5.1	(1.7)	3.6	(1.4)	3.1	(1.7)	4.6	(1.2)

The percentage of operations with a usual calving area ranged from 62.5 percent of small operations to 98.2 percent of large operations.

b. Percentage of operations that had a usual calving area

Percent Operations							
Herd Size (Number of Cows)							
Small (Fewer than 100)		**Medium** (100–499)		**Large** (500 or More)		**All Operations**	
Percent	**Std. Error**	**Percent**	**Std. Error**	**Percent**	**Std. Error**	**Percent**	**Std. Error**
62.5	(3.8)	83.7	(3.3)	98.2	(1.2)	70.1	(2.7)

Photo courtesy of Dr. Jason Lombard

6. Bedding types

Note: Some of the bedding types listed in the following tables are more commonly referred to as stall bases (i.e., the materials are covered with bedding) and are classified as such in Section II: Facility and Cow Assessments.

The ideal bedding for cows is dry and clean, provides cushion, and does not support bacterial growth. Sand has these characteristics and is one of the best bedding options for cows, although sand can lead to excessive wear of manure-handling equipment. For lactating cows, straw and/or hay was used on 54.1 percent of operations, representing 33.4 percent of cows. Sawdust/wood products and rubber mats were used on similar percentages of operations (35.0 and 30.2 percent, respectively), although sawdust/wood products were used for a higher percentage of cows (31.2 percent) than were rubber mats (18.5 percent). Sand was used on 21.9 percent of operations and for 30.3 percent of cows.

Straw and/or hay was used as bedding for dry cows on 62.2 percent of operations, representing 47.2 percent of cows. Most operations (92.5 percent) provided bedding to dry cows, and most dry cows (92.7 percent) had access to bedding.

a. Percentage of operations (and percentage of cows on these operations) by type of bedding used for *lactating* and *dry* cows during the last quarter of 2006

	Percent Operations				Percent Cows			
	Lactating Cows		Dry Cows		Lactating Cows		Dry Cows	
Bedding Type	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Straw and/or hay	54.1	(2.7)	62.2	(2.7)	33.4	(2.8)	47.2	(3.2)
Sand	21.9	(2.0)	14.4	(1.7)	30.3	(2.6)	19.0	(2.0)
Sawdust/wood products	35.0	(2.6)	25.2	(2.3)	31.2	(2.8)	28.2	(2.6)
Composted/ dried manure	3.9	(0.5)	4.8	(0.8)	24.2	(2.6)	23.5	(2.9)
Rubber mats	30.2	(2.7)	15.2	(2.2)	18.5	(2.1)	11.8	(2.3)
Rubber tires	1.6	(0.6)	1.0	(0.5)	1.1	(0.4)	0.7	(0.3)
Shredded newspaper	5.2	(1.2)	3.6	(1.1)	3.1	(0.7)	2.5	(0.8)
Mattresses	23.7	(2.4)	10.6	(1.8)	20.1	(1.9)	9.5	(1.4)
Corn cobs and stalks	11.0	(1.9)	18.5	(2.2)	5.7	(1.0)	10.7	(1.3)
Waterbeds	1.7	(0.8)	0.3	(0.3)	2.3	(1.0)	0.4	(0.3)
Other	11.7	(1.9)	9.5	(1.7)	13.3	(2.5)	12.4	(2.5)
Any	97.0	(0.8)	92.5	(1.4)	94.9	(1.9)	92.7	(1.9)

The primary bedding types used for lactating and dry cows in the last quarter of 2006 were straw and/or hay, sand, sawdust/wood products, or composted/dried manure. Composted/dried manure was used on less than 5 percent of operations, but these operations represented almost 25 percent of cows, suggesting that mostly large operations were using this bedding type.

b. For operations that used bedding during the last quarter of 2006, percentage of operations (and percentage of cows on these operations) by primary bedding type used for *lactating* and *dry* cows

	Percent Operations				Percent Cows			
	Lactating Cows		Dry Cows		Lactating Cows		Dry Cows	
Bedding Type	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Straw and/or hay	37.3	(2.9)	43.1	(3.0)	21.1	(2.6)	27.3	(2.6)
Sand	18.0	(2.0)	13.2	(1.8)	25.8	(2.7)	17.5	(2.1)
Sawdust/wood products	21.1	(2.2)	15.9	(2.1)	16.4	(1.7)	15.6	(2.3)
Composted/ dried manure	3.8	(0.5)	4.0	(0.7)	24.9	(2.5)	23.7	(3.0)
Rubber mats	1.7	(0.7)	2.3	(1.0)	0.8	(0.4)	1.8	(0.9)
Rubber tires	0.0	(--)	0.0	(--)	0.0	(--)	0.0	(--)
Shredded newspaper	1.0	(0.4)	1.0	(0.8)	0.5	(0.2)	0.4	(0.3)
Mattresses	5.6	(1.6)	3.8	(1.5)	2.6	(0.7)	1.8	(0.6)
Corn cobs and stalks	2.7	(1.1)	9.3	(1.6)	1.1	(0.4)	5.1	(0.9)
Waterbeds	0.6	(0.4)	0.4	(0.3)	1.2	(0.8)	0.3	(0.3)
Other	8.2	(1.6)	7.0	(1.6)	5.6	(1.3)	6.5	(1.7)
Total	100.0		100.0		100.0		100.0	

7. Feedline and feeding practices

The configuration of the feedline can impact the feeding behavior of dairy cattle. An increased amount of feedbunk space per cow and some form of physical separation between cows—such as the use of headlocks—reduce competition and have the greatest positive impact on subordinate cows. The most common feedline for small operations was a tie stall (46.2 percent of operations) while post and rail was the most common feedline on medium operations (37.1 percent of operations). The majority of large operations (79.6 percent) used headlocks at the feedline.

a. Percentage of operations by feedline used for the majority of lactating cows and by herd size

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		Medium (100–499)		Large (500 or More)		All Operations	
Feedline	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Tie stall	46.2	(3.8)	9.2	(2.8)	0.0	(--)	34.1	(2.8)
Stanchion	14.2	(2.8)	3.9	(1.5)	0.0	(--)	10.7	(1.9)
Post and rail	11.3	(2.2)	37.1	(4.0)	15.7	(4.1)	18.0	(1.9)
Headlocks	3.8	(1.2)	22.2	(3.2)	79.6	(4.7)	13.2	(1.3)
Elevated feed bunk in pen	17.8	(2.7)	20.3	(3.2)	0.1	(0.1)	17.3	(2.0)
Other	6.7	(1.8)	7.3	(2.0)	4.6	(2.5)	6.7	(1.3)
Total	100.0		100.0		100.0		100.0	

Photo courtesy of Dr. Jason Lombard

Separating close-up cows makes it possible to change feeding strategies, such as increasing energy levels or adding anionic salts to the diet. The percentage of operations that separated close-up cows increased as herd size increased. Overall, 57.1 percent of all operations separated close-up cows from other dry cows.

b. Percentage of operations that separated close-up cows from other dry cows, by herd size

Percent Operations							
Herd Size (Number of Cows)							
Small (Fewer than 100)		**Medium** (100–499)		**Large** (500 or More)		**All Operations**	
Percent	**Std. Error**	**Percent**	**Std. Error**	**Percent**	**Std. Error**	**Percent**	**Std. Error**
47.1	(3.9)	74.9	(3.7)	96.0	(2.1)	57.1	(2.9)

8. Water sources and chlorination

Water is the most important nutrient for cows (NRC, 2001). Lactating cows consume, either directly or in feed, between 20 and 35 gallons of water per day. In addition to providing clean water, cattle water sources should be easy to clean, readily accessible, and always available. A water tank or trough was the most common water source across all herd sizes.

a. Percentage of operations by source of drinking water for any cows during the previous 12 months, and by herd size

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		Medium (100–499)		Large (500 or More)		All Operations	
Water Source	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Single cup/bowl waterer used by one cow only	13.3	(2.8)	8.6	(2.6)	2.4	(1.9)	11.4	(2.0)
Single cup/bowl waterer used by multiple cows	74.5	(3.1)	47.7	(4.2)	15.0	(4.4)	64.1	(2.4)
Water tank or trough (covered or uncovered)	91.8	(2.1)	97.4	(1.6)	92.9	(3.4)	93.2	(1.5)
Lake, pond, stream, river, etc.	37.2	(3.7)	29.2	(3.7)	8.7	(2.9)	33.4	(2.7)
Other source	4.4	(1.7)	3.5	(1.5)	0.6	(0.5)	3.9	(1.3)

A higher percentage of operations in the East region used single cup/bowl waterers used by one or multiple cows compared with operations in the West region.

b. Percentage of operations by source of drinking water for any cows during the previous 12 months, and by region

	Percent Operations			
	Region			
	West		East	
Water Source	Percent	Std. Error	Percent	Std. Error
Single cup/bowl waterer used by one cow only	2.2	(1.6)	12.3	(2.2)
Single cup/bowl waterer used by multiple cows	12.9	(3.5)	69.0	(2.6)
Water tank or trough (covered or uncovered)	94.8	(2.5)	93.1	(1.6)
Lake, pond, stream, river, etc.	21.7	(4.7)	34.6	(2.9)
Other source	2.1	(1.1)	4.1	(1.4)

Cleaning water sources may reduce cattle exposure to pathogens such as *E. coli* and *Salmonella*. The average number of times per year that dairy operations cleaned water sources varied. About 1 of 3 operations cleaned single cup/bowl waterers for 1 cow or water tank/trough 13 or more times per year. No cleaning was reported on 14.2 percent of operations using a single cup/bowl waterer for one cow, on 24.2 percent of operations using a single cup/bowl waterer for multiple cows, and on 4.6 percent of operations using a water tank/trough.

c. Percentage of operations by average number of times per year water sources were drained and cleaned, and by water source

	Percent Operations					
	Water Source					
	Single Cup/Bowl, One Cow		Single Cup/Bowl, Multiple Cows		Water Tank/ Trough	
Number of Times	Percent	Std. Error	Percent	Std. Error	Percent	Std. Error
0	14.2	(7.3)	24.2	(3.9)	4.6	(1.4)
1 to 4	27.0	(10.4)	37.0	(4.3)	37.1	(3.2)
5 to 12	26.2	(10.4)	18.7	(3.4)	24.1	(2.8)
13 or more	32.6	(10.2)	20.1	(3.1)	34.2	(2.8)
Total	100.0		100.0		100.0	

Chlorinating water sources may reduce bacterial counts. Only 8.7 percent of operations used chlorinated water for cows. A higher percentage of medium operations (14.9 percent) than small operations (6.0 percent) used chlorinated water. These percentages may not reflect water sources that are chlorinated prior to arriving at the operations, such as municipal water supplies.

d. Percentage of operations by whether usual water source for cows was chlorinated, and by herd size

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100–499)		**Large** (500 or More)		**All Operations**	
Chlorinated Water	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Yes	6.0	(1.4)	14.9	(2.9)	13.8	(3.8)	8.7	(1.2)
Do not know	0.9	(0.7)	1.8	(1.0)	0.6	(0.3)	1.1	(0.5)
No	93.1	(1.5)	83.3	(3.0)	85.6	(3.8)	90.2	(1.3)
Total	100.0		100.0		100.0		100.0	

There were no regional differences in the percentages of operations that used or did not use chlorinated water for cows.

e. Percentage of operations by whether usual water source for cows was chlorinated, and by region

	Percent Operations			
	Region			
	West		East	
Chlorinated Water	Percent	Std. Error	Percent	Std. Error
Yes	16.7	(4.0)	7.9	(1.3)
Do not know	0.4	(0.4)	1.2	(0.6)
No	82.9	(4.0)	90.9	(1.4)
Total	100.0		100.0	

Photo courtesy of Dr. Jason Lombard

Section II: Facility and Cow Assessments

A. Facility Assessments[1]

Note: Data for all estimates in Section II A were obtained from operations with 30 or more cows that completed the cow comfort assessment (n=485). Housing types in this section refer to the buildings or areas that housed the majority of fresh (recently calved) cows. For most operations, these housing areas also housed the majority of lactating cows.

1. Housing types

Note: "other multiple-animal area" housing includes pasture, loafing areas, or a combination of freestalls and open housing, such as dry lot, pasture, or other loose-housing systems.

Almost 8 of 10 operations housed lactating cows in either tie-stall or freestall barns (39.3 and 37.7 percent, respectively). The majority of small operations (53.4 percent) housed cows in tie-stall barns, while more than 70 percent of medium and large operations (76.8 and 73.7 percent, respectively) housed cows in freestall barns. The use of tie-stall and stanchion barns decreased as herd size increased; large operations did not use either housing type. A higher percentage of large operations (16.3 percent) housed cows in dry lots compared with medium operations (3.6 percent).

a. Percentage of operations by housing type and by herd size

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		Medium (100–499)		Large (500 or More)		All Operations	
Housing Type	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Tie stall	53.4	(4.2)	10.2	(3.2)	0.0	(--)	39.3	(3.1)
Stanchion	18.1	(3.4)	2.6	(1.8)	0.0	(--)	13.1	(2.4)
Freestall	20.3	(3.0)	76.8	(3.9)	73.7	(5.6)	37.7	(2.5)
Dry lot	4.0	(1.8)	3.6	(1.0)	16.3	(4.6)	4.7	(1.3)
Other multiple-animal area	4.2	(1.2)	6.8	(1.8)	10.0	(4.1)	5.2	(1.0)
Total	100.0		100.0		100.0		100.0	

[1] Freestall components and measurements included in the assessments are presented in Appendix III, p 166.

The diversity of housing types between regions was evident. Operations in the West region housed cows primarily in freestall barns and dry lots (57.1 and 25.0 percent of operations, respectively), while operations in the East region used primarily tie-stall, freestall, and stanchion barns (43.1, 35.8, and 14.4 percent of operations, respectively).

b. Percentage of operations by housing type and by region

	Percent Operations			
	Region			
	West		East	
Housing Type	Percent	Std. Error	Percent	Std. Error
Tie stall	0.0	(--)	43.1	(3.4)
Stanchion	0.0	(--)	14.4	(2.7)
Freestall	57.1	(5.6)	35.8	(2.7)
Dry lot	25.0	(5.5)	2.7	(1.3)
Other multiple-animal area	17.9	(5.4)	4.0	(0.9)
Total	100.0		100.0	

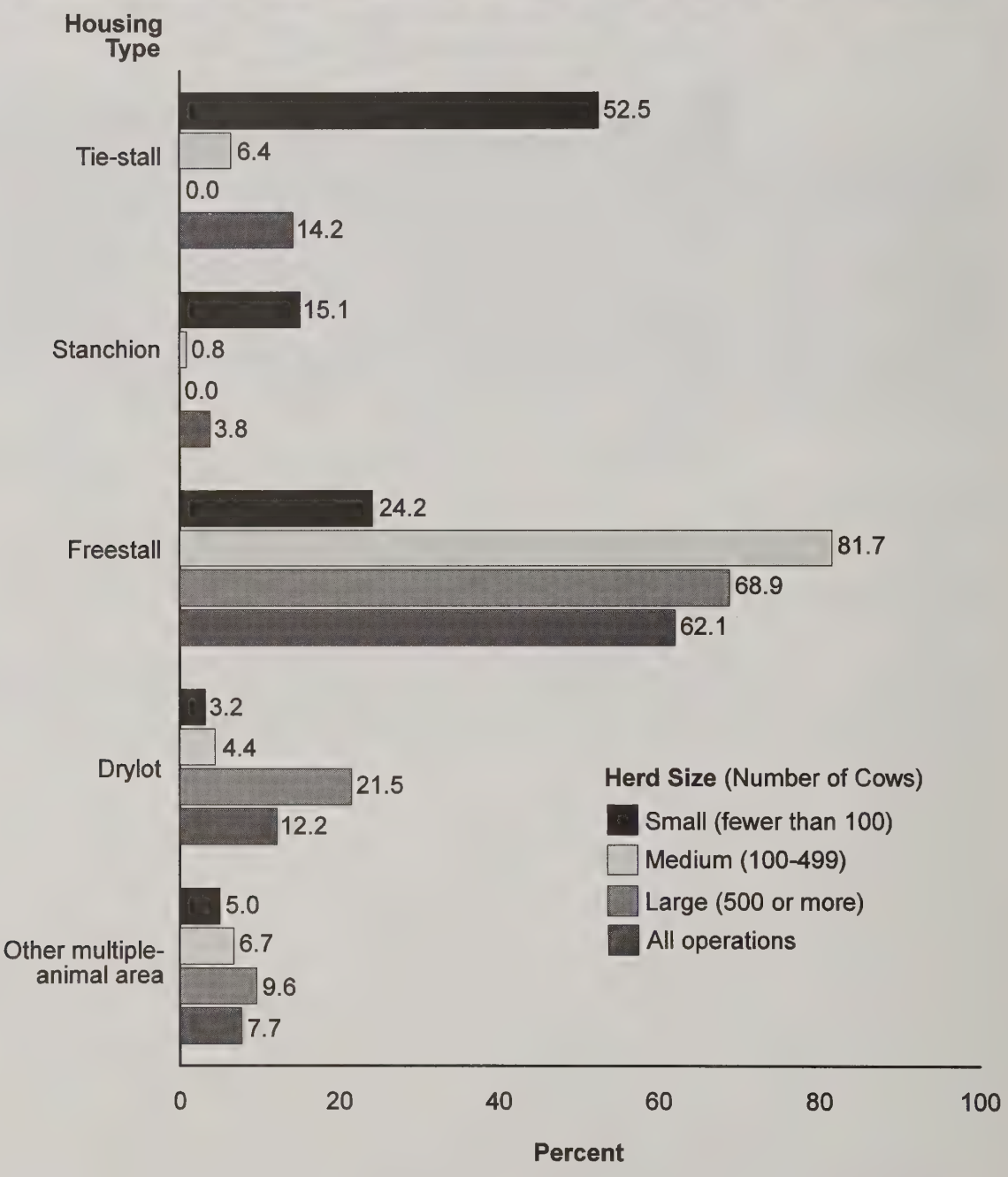
Overall, the majority of cows (62.1 percent) were housed in freestall barns. More than one-half of cows on small operations (52.5 percent) were housed in tie-stall barns, while more than two of three cows on medium and large operations were housed in freestall barns (81.7 and 68.9 percent of operations, respectively).

c. Percentage of lactating cows by housing type and by herd size

	Percent Cows*							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		Medium (100–499)		Large (500 or More)		All Operations	
Housing Type	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Tie stall	52.5	(4.2)	6.4	(2.2)	0.0	(--)	14.2	(1.4)
Stanchion	15.1	(3.0)	0.8	(0.6)	0.0	(--)	3.8	(0.7)
Freestall	24.2	(3.3)	81.7	(3.0)	68.9	(7.5)	62.1	(3.7)
Dry lot	3.2	(1.3)	4.4	(1.2)	21.5	(7.1)	12.2	(3.6)
Other multiple-animal area	5.0	(1.6)	6.7	(1.8)	9.6	(4.5)	7.7	(2.2)
Total	100.0		100.0		100.0		100.0	

*As a percentage of cows present at the time of the interview.

Percentage of Lactating Cows* by Housing Type and by Herd Size



*As a percentage of cows present at the time of the interview.

The majority of cows in both the West and the East regions were housed in freestall barns (58.6 and 64.5 percent, respectively).

d. Percentage of cows by housing type and by region

	Percent Cows*			
	Region			
	West		East	
Housing Type	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Tie-stall barn	0.0	(--)	24.1	(2.2)
Stanchion barn	0.0	(--)	6.4	(1.2)
Freestall barn	58.6	(8.4)	64.5	(2.2)
Dry lot	28.1	(8.0)	1.3	(0.6)
Other multiple-animal area	13.3	(5.3)	3.7	(0.8)
Total	100.0		100.0	

*As a percentage of cows present at the time of the interview.

2. Housing age

Note: Due to small sample sizes, operations with dry lot facilities are included with operations that had other multiple-animal areas.

On average, stanchion barns were constructed in 1949 and were the oldest housing type. Freestall barns and other multiple-animal areas were constructed more recently than tie-stall barns. For all operations, 1976 was the average year of construction for all housing types.

a. Operation average year of construction, by housing type

Operation Average Year of Construction									
Housing Type									
Tie stall		Stanchion		Freestall		Other Multiple-animal Area		All Operations	
Avg.	Std. Error	Avg.	Std. Error	Avg.	Std. Error	Avg.	Std. Error	Avg.	Std. Error
1971	(3.4)	1949	(5.9)	1989	(1.0)	1983	(3.6)	1976	(1.8)

The majority of tie-stall barns (71.6 percent) were built between 1950 and 1999, while the majority of stanchion barns (66.9 percent) were built prior to 1975. The majority of other housing types were built in 1975 or later.

b. Percentage of operations by year housing was constructed and by housing type

	Percent Operations									
	Housing Type									
	Tie stall		Stanchion		Freestall		Other Multiple-animal Area		All Operations	
Year	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Before 1950	15.6	(4.3)	43.7	(10.0)	0.0	(--)	5.5	(4.1)	12.5	(2.3)
1950 to 1974	32.2	(5.5)	23.2	(8.2)	13.6	(2.7)	24.7	(7.7)	23.3	(2.8)
1975 to 1999	39.4	(5.7)	30.0	(9.3)	62.0	(4.1)	41.0	(7.8)	46.9	(3.2)
2000 or later	12.8	(3.9)	3.1	(3.0)	24.4	(3.6)	28.8	(9.2)	17.3	(2.3)
Total	100.0		100.0		100.0		100.0		100.0	

3. Cow space allotment

Note: Current space allotment refers to the number of cows present in the building or area at the time of the assessment. Minimum space allotment refers to the maximum number of cows ever housed in the area/pen. Average space allotment refers to the usual number of cows housed in the area assessed.

The amount of space per cow is usually expressed as the number of square feet in the pen divided by the number of cows in the pen. Recommendations as to how many square feet an individual cow needs depend on many factors, e.g., total precipitation, presence of shade, and other factors. Ideally, each cow should have at least 110 square feet of pen space; transition cows should have 120 square feet each (Cook, 2008). Square feet per cow is not usually calculated for areas in which cows have their own stalls, i.e., tie-stall and stanchion barns. When assessing freestall operations, other measures, such as cows per stall or cows per headlock, are more commonly used.

The majority of freestall operations (62.0 percent) provided fewer than 100 square feet per cow at the time of the assessment, which was similar to the average space allotment. At minimum space allotment (maximum cows in pen), almost three-fourths of freestall operations (74.4 percent) provided fewer than 100 square feet per cow.

a. Percentage of freestall operations by current, minimum, and average space allotment (sq ft/cow)

	Percent Operations					
	Space Allotment					
	Current		Minimum		Average	
Square Feet per Cow	Percent	Std. Error	Percent	Std. Error	Percent	Std. Error
Fewer than 100	62.0	(4.2)	74.4	(3.8)	67.1	(4.0)
100 to 199	28.4	(3.9)	19.6	(3.3)	25.5	(3.6)
200 to 399	9.0	(2.9)	5.4	(2.5)	6.8	(2.6)
400 to 799	0.6	(0.6)	0.6	(0.6)	0.6	(0.6)
800 to 1,599	0.0	(--)	0.0	(--)	0.0	(--)
1,600 or more	0.0	(--)	0.0	(--)	0.0	(--)
Total	100.0		100.0		100.0	

About 9 of 10 operations with other multiple-animal areas (92.3 percent) provided 100 or more square feet per cow at the time of the assessment. More than one of four operations with other multiple-animal areas (28.3 percent) provided 1,600 square feet per cow or more at the time of the assessment. About 8 of 10 operations (80.1 percent) provided 100 or more square feet per cow or more at minimum space allotment (maximum cows in pen).

b. Percentage of other multiple-animal area operations by current, minimum, and average space allotment (sq ft/cow)

	Percent Operations					
	Space Allotment					
	Current		Minimum		Average	
Square Feet per Cow	Percent	Std. Error	Percent	Std. Error	Percent	Std. Error
Fewer than 100	7.7	(3.5)	19.9	(6.2)	9.3	(3.8)
100 to 199	27.8	(8.2)	17.4	(7.5)	27.9	(8.3)
200 to 399	10.4	(5.6)	15.4	(6.1)	10.3	(5.7)
400 to 799	14.4	(4.0)	15.2	(4.3)	15.6	(4.3)
800 to 1,599	11.4	(4.8)	8.3	(4.3)	10.6	(4.7)
1,600 or more	28.3	(9.1)	23.8	(9.3)	26.3	(9.2)
Total	100.0		100.0		100.0	

The percentage of operations with freestalls and other multiple-animal areas by average space allotment per cow was similar to the current space allotment determined at the time of the assessment. At minimum space allotment (maximum cows in pen), almost two of three operations (63.6 percent) provided fewer than 100 square feet per cow.

c. Percentage of operations with freestalls and other multiple-animal areas by current, minimum, and average space allotment (sq ft/cow)

	Percent Operations					
	Space Allotment					
	Current		Minimum		Average	
Square Feet per Cow	Percent	Std. Error	Percent	Std. Error	Percent	Std. Error
Fewer than 100	51.1	(3.7)	63.6	(3.7)	55.7	(3.7)
100 to 199	28.3	(3.5)	19.2	(3.1)	26.0	(3.3)
200 to 399	9.3	(2.6)	7.4	(2.3)	7.5	(2.4)
400 to 799	3.3	(0.9)	3.5	(0.9)	3.5	(0.9)
800 to 1,599	2.3	(0.9)	1.6	(0.8)	2.1	(0.9)
1,600 or more	5.7	(2.2)	4.7	(2.1)	5.2	(2.1)
Total	100.0		100.0		100.0	

4. Cows per stall

On operations with freestall barns, the number of cows per stall is one of the most commonly used measures of density. Studies have shown that when cows are not allowed to lie down or eat for a period of time, they choose to rest rather than eat when access to both is renewed. Cows-per-stall stocking rates of 1.1 or higher (fewer stalls than cows) increased idle standing time (Krawczel et al., 2008), and when rates were above 1.5, lying times were reduced as well (Wierenga and Hopster, 1990; Fregonesi et al., 2007). Most references suggest that having 1.1 to 1.15 cows per stall is not associated with behavioral changes. It is important to note that these assessments were in buildings or pens that housed the majority of fresh cows, where recommended stocking density is 0.8 cows per stall (Nordlund et al., 2006).

Almost 3 of 10 freestall operations (30.4 percent) had 1.10 or more cows per stall, which equates to a stocking density of 110 percent or more at the time of the assessment (current). The majority of operations averaged less than 1.05 cows per stall. At maximum density, almost one-half of operations (48.5 percent) had 1.10 or more cows per stall. The average density was similar to the current density, with 28.8 percent of operations having 1.10 or more cows per stall.

Percentage of freestall operations by current, maximum, and average number of cows per stall

	Percent Operations					
	Density					
	Current		Maximum		Average	
Cows per Stall	Percent	Std. Error	Percent	Std. Error	Percent	Std. Error
Less than 0.95	38.9	(4.2)	13.4	(3.5)	34.9	(4.1)
0.95 to 0.99	7.4	(1.9)	3.1	(1.1)	8.1	(2.0)
1.00 to 1.04	12.6	(2.7)	25.7	(3.7)	16.2	(3.1)
1.05 to 1.09	10.7	(2.3)	9.3	(2.2)	12.0	(2.5)
1.10 or more	30.4	(3.7)	48.5	(4.2)	28.8	(3.7)
Total	100.0		100.0		100.0	

5. Feedbunk space

Feedbunk space on tie-stall and stanchion operations is usually not an issue, since the feedbunk space is the same as the width of the stall and there is no competition for feed. On operations with loose-housing systems (freestall barns, dry lots, or other multiple-animal areas), adequate bunk space ensures that cows always have access to feed. The recommended bunk space in loose-housing facilities is 24 to 30 inches per cow. Providing adequate bunk space is especially critical in minimizing the normal decrease in feed intake observed around calving; 30 inches of bunk space is recommended for transition cows from 3 weeks before to 3 weeks after calving. Decreased bunk space has been associated with increased competition and slug feeding (increased rate of eating), which can lead to rumen acidosis (Shaver, 2002).

All tie-stall and stanchion operations provided 32 inches or more of feedbunk space per cow (data not shown in table below). In contrast, more than one-half of freestall operations (57.1 percent) provided fewer than 24 inches of bunk space at the time of the assessment. At maximum cow numbers (minimum feedbunk space), 67.9 percent of freestall operations provided less than the recommended minimum of 24 inches. Feedbunk space was similar for current and average cow numbers in the pen.

a. Percentage of freestall operations by current, minimum, and average feedbunk space per cow (inches)

	Percent Operations					
	Feedbunk Space					
	Current		Minimum		Average	
Inches per Cow	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Fewer than 20.0	34.4	(3.8)	48.6	(4.2)	36.0	(3.9)
20.0 to 23.9	22.7	(3.4)	19.3	(3.1)	22.2	(3.6)
24.0 to 27.9	14.0	(3.0)	17.1	(3.2)	13.5	(2.5)
28.0 to 31.9	8.6	(2.1)	3.7	(1.2)	13.9	(2.9)
32.0 or more	20.3	(3.7)	11.3	(2.9)	14.4	(3.2)
Total	100.0		100.0		100.0	

About two-thirds of operations with other multiple-animal areas (65.9 percent) provided at least the recommended minimum 24 inches of bunk space at current cow numbers. At maximum cow numbers, less than one-half of operations (47.2 percent) provided the recommended amount of space. As with freestall operations, the current and average feedbunk space estimates were similar.

b. Percentage of other multiple-animal operations by current, minimum, and average feedbunk space per cow (inches)

	Percent Operations					
	Feedbunk Space					
	Current		Minimum		Average	
Inches per Cow	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Fewer than 20.0	26.2	(8.6)	40.9	(9.2)	28.8	(8.7)
20.0 to 23.9	7.9	(3.4)	11.9	(4.3)	7.7	(3.5)
24.0 to 27.9	24.7	(7.5)	36.9	(9.1)	27.0	(7.8)
28.0 to 31.9	23.5	(8.6)	6.7	(4.7)	16.9	(8.3)
32.0 or more	17.7	(5.8)	3.6	(1.8)	19.6	(6.0)
Total	100.0		100.0		100.0	

More than one-half of operations with freestalls and other multiple-animal areas provided less than the recommended minimum 24 inches of bunk space at current, maximum (minimum feedbunk space per cow), and average cow numbers (52.5, 64.9, and 54.0 percent, respectively).

c. Percentage of operations with freestalls and other multiple-animal areas by current, minimum, and average feedbunk space per cow (inches)

	Percent Operations					
	Feedbunk Space					
	Current		Minimum		Average	
Inches per Cow	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Fewer than 20.0	32.8	(3.5)	47.1	(3.8)	34.6	(3.5)
20.0 to 23.9	19.7	(2.9)	17.8	(2.6)	19.4	(3.1)
24.0 to 27.9	16.1	(2.8)	21.0	(3.2)	16.1	(2.5)
28.0 to 31.9	11.6	(2.5)	4.3	(1.4)	14.5	(2.9)
32.0 or more	19.8	(3.2)	9.8	(2.4)	15.4	(2.8)
Total	100.0		100.0		100.0	

In addition to adequate bunk space per cow, it is important to distribute feed along the entire feedbunk. If feed is not distributed along the entire bunk, the percentage of the feedbunk space that provides accessible feed is reduced. More than 80 percent of operations had feed accessible along more than 75 percent of the feedbunk.

d. Percentage of operations by percentage of the feedbunk that provided easily accessible feed, and by housing type

	Percent Operations									
	Housing Type									
	Tie stall		Stanchion		Freestall		Dry lot		All Operations	
Percent of Feedbunk	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Less than 26	4.0	(2.7)	3.0	(2.9)	3.1	(1.4)	9.2	(4.7)	4.1	(1.3)
26 to 75	14.5	(4.7)	9.0	(5.0)	9.8	(2.4)	7.6	(3.1)	11.2	(2.2)
More than 75	81.5	(5.0)	88.0	(5.7)	87.1	(2.7)	83.2	(5.5)	84.7	(2.5)
Total	100.0		100.0		100.0		100.0		100.0	

Photo courtesy of Dr. Jason Lombard

6. Headlocks

Headlocks are used to restrain cattle while performing procedures such as vaccination, treatment, and reproductive exams. Additionally, headlocks are usually positioned between the cow alley and feed alley, which allows cows access to feed when they put their heads through the headlocks. Headlocks reduce feeding time compared with a post-and-rail feedline but reduce the number of times cows are displaced from the bunk by other cows (Huzzey et al., 2006). Approximately 4 of 10 operations (40.2 percent) with loose-housing systems had headlocks at the feedline.

a. For operations with loose-housing systems, percentage of operations with headlocks, by housing type

Percent Operations					
Housing Type					
Freestall		Other Multiple-animal Area		All Operations	
Percent	Std. Error	Percent	Std. Error	Percent	Std. Error
43.2	(3.9)	28.9	(5.9)	40.2	(3.4)

Ideally, the average number of cows per headlock would be 1.00 or less so that each cow has the opportunity to access feed at any time. If the average number of cows per headlock is more than 1.00, then problems similar to those observed with decreased feed-bunk space are observed: decreased feeding times, increased competition, and increased idle standing in the feed area (Huzzey et al., 2006).

The percentage of freestall operations was similar for both current and average cows per headlock. About one of three operations averaged less than 1.00 cows per headlock at current and average cows per headlock. At the maximum cows per headlock, 42.7 percent of operations averaged 1.20 or more cows per headlock.

b. For freestall operations with headlocks, percentage of operations by current, maximum, and average number of cows per headlock

	Percent Operations					
	Cows per Headlock					
	Current		Maximum		Average	
Cows per Headlock	Percent	Std. Error	Percent	Std. Error	Percent	Std. Error
Less than 1.00	32.8	(6.0)	15.6	(4.5)	35.4	(6.1)
1.00 to 1.09	21.3	(4.6)	21.8	(5.3)	20.2	(4.5)
1.10 to 1.19	15.5	(4.8)	19.9	(4.8)	16.6	(5.1)
1.20 or more	30.4	(5.5)	42.7	(6.1)	27.8	(5.1)
Total	100.0		100.0		100.0	

The majority of operations with other multiple-animal areas averaged less than 1.00 cow per headlock at current stocking levels (53.7 percent) and at average stocking levels (50.1 percent). Almost two of three operations with other multiple-animal areas (64.9 percent) averaged 1.00 to 1.09 cows per headlock.

c. For other multiple-animal area operations with headlocks, percentage of operations by current, maximum, and average number of cows per headlock

	Percent Operations					
	Cows per Headlock					
	Current		Maximum		Average	
Cows per Headlock	Percent	Std. Error	Percent	Std. Error	Percent	Std. Error
Less than 1.00	53.7	(10.2)	7.1	(5.0)	50.1	(10.5)
1.00 to 1.09	32.6	(10.0)	64.9	(10.0)	36.1	(10.5)
1.10 to 1.19	11.7	(7.6)	20.0	(8.8)	11.7	(7.6)
1.20 or more	2.0	(1.7)	8.0	(5.9)	2.1	(1.7)
Total	100.0		100.0		100.0	

More than one-third of all operations (36.8 percent) averaged 1.20 cows per headlock or more when at maximum capacity, while 14.1 percent averaged less than 1.00 cow per headlock.

d. For operations with headlocks, percentage of all operations by current, maximum, and average number of cows per headlock

	Percent Operations					
	Cows per Headlock					
	Current		Maximum		Average	
Cows per Headlock	Percent	Std. Error	Percent	Std. Error	Percent	Std. Error
Less than 1.00	36.4	(5.2)	14.1	(3.8)	37.9	(5.3)
1.00 to 1.09	23.3	(4.2)	29.2	(4.8)	23.0	(4.2)
1.10 to 1.19	14.8	(4.2)	19.9	(4.3)	15.7	(4.4)
1.20 or more	25.5	(4.6)	36.8	(5.2)	23.4	(4.3)
Total	100.0		100.0		100.0	

7. Stall base

Stall base refers to material immediately under the bedding. Stall base and quantity of bedding are important in keeping cows clean and in preventing hock injuries. Abrasive stall bases, such as rubber mats and mattresses, have been associated with increased incidence of hock lesions (Weary and Taszkum, 2000; Fulwider et al., 2007).

Concrete was used as a stall base on 33.2 percent of operations. Concrete was used on a higher percentage of stanchion operations than freestall operations (59.4 and 20.8 percent, respectively). As expected, dirt was not used on any tie-stall or stanchion operations but was used on 43.7 percent of operations with other multiple-animal areas, which included dry lots. Rubber mats were used by about one of three tie-stall and stanchion operations. Mattresses were used by approximately 25 percent of tie-stall and freestall operations. "Other" stall bases were generally a combination of the types listed.

Percentage of operations by type of stall base used and by housing type

	Percent Operations									
	Housing Type									
	Tie stall		Stanchion		Freestall		Other Multiple-animal Area		All Operations	
Stall Base Type	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Concrete	35.8	(5.4)	59.4	(10.6)	20.8	(3.4)	35.0	(9.0)	33.2	(3.1)
Dirt	0.0	(--)	0.0	(--)	29.2	(3.6)	43.7	(8.8)	15.2	(1.8)
Rubber mat	31.2	(5.1)	35.5	(10.3)	9.2	(2.3)	4.1	(4.1)	20.8	(2.6)
Mattress	29.5	(4.9)	0.0	(--)	22.1	(3.2)	0.1	(0.1)	20.0	(2.5)
Waterbed	1.1	(0.8)	0.0	(--)	1.7	(1.1)	0.0	(--)	1.1	(0.5)
Other	2.4	(1.5)	5.1	(4.9)	17.0	(3.3)	17.1	(5.4)	9.7	(1.7)
Total	100.0		100.0		100.0		100.0		100.0	

8. Bedding

Bedding is an important aspect of cow comfort since cows generally spend 8 to 16 hours per day lying down (Cook, 2010). Bedding is used to cover the stall base, and the ideal bedding for cattle is dry, clean, easy to maintain, provides cushion and insulation, absorbs moisture, and discourages bacterial growth. Sand is considered the best bedding because of the cushion and traction it provides, especially to lame cows. Sand also appears to have an effect on hygiene since cows that bed on sand are cleaner than cows that bed on mattresses. However, sand is not necessarily easy to maintain and does support bacterial growth once contaminated (Cook, 2004). Organic bedding types should be removed and replaced frequently since they quickly become soiled and contaminated with bacteria.

Straw was the single most common bedding type used in tie stalls, stanchion housing, and all operation types (45.4, 64.7, and 34.7 percent, respectively). Sand—either fine or coarse—was used in 45.0 percent of freestall housing. More than one-third of other multiple-animal areas did not have bedding, since this group included dry lot housing in which cows lie primarily on dirt. "Other" bedding types included hay or a combination of the types listed.

a. Percentage of operations by bedding type and by housing type

	Percent Operations									
	Housing Type									
	Tie stall		Stanchion		Freestall		Other Multiple-animal Area		All Operations	
Bedding Type	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Straw	45.4	(5.6)	64.7	(10.1)	14.4	(2.9)	29.7	(7.6)	34.7	(3.1)
Sawdust	27.1	(4.8)	20.1	(8.6)	21.1	(3.1)	8.5	(3.1)	22.1	(2.5)
Fine sand	0.8	(0.8)	0.0	(--)	26.4	(3.8)	0.0	(--)	10.3	(1.7)
Coarse sand	1.0	(1.0)	0.0	(--)	18.6	(3.4)	0.0	(--)	7.4	(1.4)
Composted manure	0.0	(--)	0.0	(--)	3.2	(1.0)	2.7	(1.9)	1.5	(0.4)
Dried manure	0.0	(--)	0.0	(--)	4.1	(1.2)	8.8	(3.2)	2.4	(0.5)
Shredded newspaper	1.3	(0.9)	0.0	(--)	0.6	(0.4)	1.5	(1.5)	0.9	(0.4)
Other	18.9	(4.2)	13.6	(7.9)	10.2	(2.3)	10.4	(4.3)	14.1	(2.2)
None	5.5	(3.2)	1.6	(1.5)	1.4	(1.3)	38.4	(8.5)	6.6	(1.7)
Total	100.0		100.0		100.0		100.0		100.0	

Almost 9 of 10 tie-stall and stanchion operations that provided bedding (87.7 and 88.3 percent, respectively) changed bedding every 1 to 2 days. Freestall operations generally bedded with sand (see previous table), which was not added to or changed as frequently as organic bedding types. Almost two of three freestall operations (64.4 percent) and one-half of operations with other multiple-animal areas (45.1 percent) changed bedding every 7 or more days. Dry lot facilities, which are included in other multiple-animal areas, generally provided bedding only during inclement weather to provide a clean, dry surface for cows.

b. For operations that provided bedding, percentage of operations by number of days between bedding additions/changes, and by housing type

Percent Operations

	Housing Type									
	Tie stall		Stanchion		Freestall		Other Multiple-animal Area		All Operations	
Days Between Bedding Additions/ Changes	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
1 to 2	87.7	(3.7)	88.3	(5.8)	21.7	(3.6)	33.7	(9.8)	58.3	(3.0)
3 to 4	6.1	(2.4)	7.8	(4.7)	11.3	(2.4)	18.8	(10.9)	9.2	(1.7)
5 to 6	0.0	(--)	0.0	(--)	2.6	(1.1)	2.4	(2.3)	1.2	(0.5)
7 or more	6.2	(3.0)	3.9	(3.8)	64.4	(4.0)	45.1	(11.7)	31.3	(2.7)
Total	100.0		100.0		100.0		100.0		100.0	

At the time of the assessment, about three of four tie-stall and stanchion operations had changed bedding within the past 24 hours.

Nearly 70 percent of all operations (69.1 percent) had changed bedding within the past 2 days.

c. For operations that provided bedding, percentage of operations by days since bedding was added/changed, and by housing type

Percent Operations

	Housing Type									
	Tie stall		Stanchion		Freestall		Other Multiple-animal Area		All Operations	
Days Since Bedding Added/ Changed	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Less than 1	73.5	(4.9)	76.3	(8.2)	18.4	(3.5)	28.6	(9.6)	49.3	(3.1)
1 to 2	18.9	(4.4)	13.8	(6.9)	23.4	(3.5)	17.2	(10.7)	19.8	(2.5)
3 to 4	4.4	(2.0)	6.9	(4.7)	13.5	(2.6)	14.7	(7.4)	9.0	(1.5)
5 to 6	1.8	(1.8)	0.0	(--)	11.1	(2.3)	7.4	(3.9)	5.6	(1.2)
7 or more	1.4	(1.3)	3.0	(2.9)	33.6	(4.0)	32.1	(12.2)	16.3	(2.1)
Total	100.0		100.0		100.0		100.0		100.0	

Cows in well-bedded stalls (defined as base not exposed and enough bedding to provide cushion) have increased lying times compared with cows lying in scant bedding (Tucker et al., 2009). Inadequate bedding over any stall base, especially mattresses, is likely to increase the incidence of hock lesions from the friction associated with cow contact with stall bases and concrete curbs (Weary and Taszkun, 2000).

At the time of the assessment, stall bases were exposed on the majority of tie-stall and stanchion operations (71.0 and 81.7 percent, respectively). Stall bases were not exposed on the majority of freestall operations (65.7 percent). On operations with other multiple-animal areas, bases (primarily dirt or concrete) were generally exposed or no bedding was present (24.5 and 44.4 percent, respectively). On 60.9 percent of all operations, stall bases were exposed or did not have bedding present.

d. Percentage of operations by bedding quantity/stall condition in the majority of stalls, and by housing type

Percent Operations

	Housing Type									
	Tie stall		Stanchion		Freestall		Other Multiple-animal Area		All Operations	
Bedding Quantity/Stall Condition	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Base not exposed, bedding level with curb	4.5	(2.0)	3.3	(3.2)	28.2	(3.6)	9.0	(3.6)	13.8	(1.8)
Base not exposed, bedding slightly dished out	18.0	(4.5)	13.5	(6.4)	37.5	(4.1)	14.3	(5.5)	24.4	(2.7)
Base exposed (less than 50 percent)	37.5	(5.2)	38.3	(9.5)	19.8	(3.3)	2.2	(1.7)	27.6	(2.8)
Base mostly exposed (more than 50 percent)	33.5	(5.5)	43.4	(10.0)	11.4	(2.7)	22.3	(8.0)	25.4	(2.9)
No bedding present*	6.5	(3.4)	1.5	(1.5)	2.6	(1.5)	44.4	(8.8)	7.9	(1.8)
Other	0.0	(--)	0.0	(--)	0.5	(0.5)	7.8	(5.0)	0.9	(0.5)
Total	100.0		100.0		100.0		100.0		100.0	

*80.9 percent of operations on which no bedding was present were dry lot operations or operations with other multiple-animal areas.

The number of days between bedding changes differed based on bedding type. The majority of operations that bedded with straw, sawdust, shredded newspaper, or "other" (primarily tie-stall and stanchion operations) added new bedding every 1 to 4 days. More than 8 of 10 operations that bedded with fine or coarse sand or composted or dried manure (primarily freestall operations) bedded stalls weekly or less often.

e. Percentage of operations by bedding type and by number of days between bedding additions/changes

	Percent Operations								
	Days Between Bedding Additions/Changes								
	1 to 2		3 to 4		5 to 6		7 or More		
Bedding Type	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Total
Straw	81.1	(4.0)	9.9	(3.2)	0.3	(0.3)	8.7	(2.7)	100.0
Sawdust	64.1	(6.1)	11.2	(3.5)	1.9	(1.0)	22.8	(5.4)	100.0
Fine sand	0.2	(0.2)	6.3	(3.6)	3.5	(3.4)	90.0	(4.8)	100.0
Coarse sand	11.5	(8.9)	5.9	(5.2)	1.0	(0.7)	81.6	(9.7)	100.0
Composted manure	0.8	(0.8)	1.4	(1.3)	0.0	(--)	97.8	(1.6)	100.0
Dried manure	7.5	(7.1)	0.4	(0.4)	0.0	(--)	92.1	(7.1)	100.0
Shredded newspaper	100.0	(--)	0.0	(--)	0.0	(--)	0.0	(--)	100.0
Other	73.1	(6.1)	11.5	(4.4)	0.8	(0.8)	14.6	(4.3)	100.0

The percentage of operations by days since bedding was last changed was similar to days between bedding changes. As expected, most operations that bedded with straw, sawdust, shredded newspaper, or "other" had added bedding within 2 days. Operations that used other bedding types were more variable in the days since last bedded, but more than 50 percent of operations using fine sand or composted or dried manure had last added new bedding 7 or more days prior to the interview.

f. Percentage of operations by bedding type and by days since bedding was added/changed

	Percent Operations										
	Days Since Bedding Added/Changed										
	Less than 1		1 to 2		3 to 4		5 to 6		7 or More		
Bedding Type	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Total
Straw	66.9	(5.3)	17.0	(4.4)	6.7	(2.5)	3.7	(2.3)	5.7	(2.0)	100.0
Sawdust	53.0	(6.5)	25.1	(5.7)	8.3	(2.9)	4.5	(1.7)	9.1	(3.3)	100.0
Fine sand	1.1	(1.1)	13.7	(5.0)	16.4	(6.1)	13.8	(5.0)	55.0	(8.2)	100.0
Coarse sand	12.3	(8.9)	35.6	(10.6)	16.2	(6.0)	7.7	(3.7)	28.2	(9.6)	100.0
Composted manure	0.8	(0.8)	35.0	(16.2)	1.4	(1.3)	2.7	(2.7)	60.1	(16.4)	100.0
Dried manure	0.0	(--)	15.4	(9.5)	18.5	(11.7)	12.5	(8.4)	53.6	(13.4)	100.0
Shredded newspaper	100.0	(--)	0.0	(--)	0.0	(--)	0.0	(--)	0.0	(--)	100.0
Other	65.8	(7.0)	16.9	(5.4)	7.1	(3.3)	4.7	(2.5)	5.5	(2.3)	100.0

More than 85 percent of operations that bedded with fine or coarse sand or composted manure did not have the stall base exposed at the time of the assessment. More than 3 of 10 operations that bedded with straw, sawdust, shredded newspaper, or "other" had more than 50 percent of the stall base exposed.

g. Percentage of operations by bedding type and by bedding quantity/stall condition in majority of stalls

	Percent Operations								
	Bedding Quantity/Stall Condition								
	Base not Exposed, Bedding Level with Curb		Base not Exposed, Bedding Slightly Dished Out		Base Exposed (Less than 50 Percent)		Base Mostly Exposed (More than 50 Percent)		
Bedding Type	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Total
Straw	3.0	(1.5)	16.3	(4.3)	48.6	(6.0)	32.1	(6.1)	100.0
Sawdust	11.9	(3.5)	24.6	(5.9)	27.5	(5.5)	36.0	(6.7)	100.0
Fine sand	43.0	(8.4)	56.7	(8.4)	0.2	(0.2)	0.1	(0.1)	100.0
Coarse sand	40.6	(10.1)	45.1	(10.7)	2.8	(2.7)	11.5	(8.6)	100.0
Composted manure	51.7	(15.3)	46.6	(15.4)	1.7	(1.3)	0.0	(--)	100.0
Dried manure	16.0	(8.6)	37.0	(12.0)	29.7	(12.1)	17.3	(8.6)	100.0
Shredded newspaper	49.9	(24.1)	0.0	(--)	7.3	(7.4)	42.8	(23.4)	100.0
Other	8.4	(4.0)	21.1	(6.9)	32.4	(7.4)	38.1	(8.7)	100.0

Frequent bedding did not equate to improved bedding quantity/stall conditions in the assessed operations. As days since bedding was added or changed increased, the percentage of operations in which the stall base was not exposed, bedding slightly dished out increased from 18.2 to 48.1 percent. Alternatively, as days since bedding increased, a lower percentage of operations had less than 50 percent of the stall base exposed (44.1 to 7.4 percent).

h. Percentage of operations by days since bedding was added/changed, and by bedding quantity/stall condition in majority of stalls

	Percent Operations								
	Bedding Quantity/Stall Condition								
	Base not Exposed, Bedding Level with Curb		Base not Exposed, Bedding Slightly Dished Out		Base Exposed (Less than 50 Percent)		Base Mostly Exposed (More than 50 Percent)		Total
Days Since Bedding Added/ Changed	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.
Less than 1	7.8	(2.5)	18.2	(4.2)	44.1	(5.0)	29.9	(5.1)	100.0
1 to 2	19.9	(4.6)	24.6	(6.1)	26.0	(6.3)	29.5	(7.0)	100.0
3 to 4	19.1	(6.2)	32.1	(7.9)	13.9	(5.5)	34.9	(8.8)	100.0
5 to 6	23.0	(8.6)	41.8	(10.7)	15.0	(7.4)	20.2	(12.0)	100.0
7 or more	27.1	(6.1)	48.1	(7.3)	7.4	(3.5)	17.4	(6.0)	100.0

9. Platform and stall lengths

Note: The following estimates refer to operations on which Holsteins were the primary breed (n=454 for all housing types).

Stall-length measurements differed by housing type. Measurements for tie-stall and stanchion operations included only the actual surface (platform or bed) in back of the stanchion or rail where cows lie. Published recommendations suggest a 70-inch bed for first lactation and a 72-inch bed for mature cows (Anderson, 2008a).

Platform lengths for stalls on tie-stall operations were generally longer than on stanchion operations. Approximately 40 percent of tie-stall operations had platform lengths of 70.0 inches or more, while all stanchion operations had platform lengths of less than 70 inches. The majority of stanchion operations (60.3 percent) had platform lengths of 60.0 to 64.9 inches.

a. For tie-stall and stanchion operations, percentage of operations by average platform length and by housing type

	Percent Operations					
	Housing Type					
	Tie stall		Stanchion		All Operations	
Average Platform Length (Inches)	Percent	Std. Error	Percent	Std. Error	Percent	Std. Error
Less than 60.0	1.4	(0.8)	20.0	(7.8)	6.1	(2.2)
60.0 to 64.9	13.4	(4.1)	60.3	(9.4)	25.3	(4.5)
65.0 to 69.9	43.7	(5.9)	19.7	(7.1)	37.6	(4.9)
70.0 to 74.9	34.5	(5.3)	0.0	(--)	25.8	(4.1)
75.0 or more	7.0	(3.2)	0.0	(--)	5.2	(2.4)
Total	100.0		100.0		100.0	

Holsteins need approximately 120 inches (10 feet) of stall length to rise in freestalls without interference (Anderson, 2008b); 96 inches (8 feet) is usually recommended for freestalls that have an open front that does not restrict lunge space; 108 inches (9 feet) is recommended for closed front stalls that have a barrier restricting the lunge space (Cook and Nordlund, 2004). For this study, the distance from the rear curb to the front post where the loops are attached was measured (see Appendix III, p166, for diagram).

More than 4 of 10 freestall operations (44.1 percent) had a stall length of 86.0 to 91.9 inches. About one of five freestall operations had stall lengths of 82.0 to 85.9 inches. Less than 20 percent of freestall operations (15.3 percent) had stall lengths greater than the recommended 96 inches.

b. Percentage of freestall operations by average stall length

Average Stall Length (Inches)	Percent Operations	Standard Error
Less than 82.0	12.3	(3.8)
82.0 to 85.9	20.7	(3.9)
86.0 to 91.9	44.1	(5.0)
92.0 to 95.9	7.6	(2.3)
96.0 or more	15.3	(3.6)
Total	100.0	

10. Stall widths

Note: The following estimates refer to operations on which Holsteins were the primary breed (n=454 for all housing types).

Stalls should be wide enough for cows to lie down and get up easily but not so wide that cows can turn around in the stall. Narrow stalls increase perching time and decrease the amount of time cows lie down. Recommended stall widths for mature cows vary by weight but are generally 50 to 54 inches (Cook and Nordlund, 2004).

Tie-stall operations generally had wider stalls than operations with other housing types. Over three-fourths of tie-stall operations (76.4 percent) had stall widths of 46 inches or more compared with about one-half of stanchion operations (47.1 percent) and approximately one-third of freestall operations (32.1 percent).

Percentage of operations by average stall width and by housing type

	Percent Operations							
	Housing Type							
	Tie stall		Stanchion		Freestall		All Operations	
Average Stall Width (Inches)	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Less than 42.0	1.6	(0.9)	33.4	(10.0)	4.9	(1.7)	7.8	(2.0)
42.0 to 43.9	5.5	(2.3)	12.0	(7.0)	22.8	(3.6)	13.5	(2.1)
44.0 to 45.9	16.5	(4.0)	7.5	(4.4)	40.2	(4.1)	24.7	(2.6)
46.0 to 47.9	31.0	(5.5)	21.4	(7.6)	26.6	(4.0)	27.7	(3.1)
48.0 to 49.9	30.1	(5.3)	23.0	(9.9)	4.9	(2.6)	18.8	(2.9)
50.0 or more	15.3	(4.4)	2.7	(2.7)	0.6	(0.5)	7.5	(2.1)
Total	100.0		100.0		100.0		100.0	

11. Neck rails

Neck rails connect the freestall loops and are common features of freestalls. These rails, which are commonly constructed of pipe or cable, are used to provide cows a gauge of how far they can enter the stall. If neck rails are properly positioned, they allow cows to stand with all four feet in the stall and help ensure that manure and urine are deposited in the alleyway. If neck rails are placed too close to the rear curb or alleyway, cows may have difficulty rising without contacting the rails and may be more likely to stand with two feet in the stall (perching). Neck rails too far from the alleyway allow cows to stand fully in the stall, which can lead to more manure and urine being deposited in stalls rather than in the alleyway (Tucker et al., 2005; Fregonessi et al., 2009). Although restrictive neck rails help keep stalls clean, they may also lead to higher lameness scores (Bernardi et al., 2009).

The suggested height and distance from the rear curb for neck rails depend on the size of the cows housed. For adult cows weighing approximately 1,200 to 1,400 pounds, neck rails should be between 40 and 50 inches above the bed (BCMAF, 1994; Cook and Nordlund, 2004; Tucker et al., 2005). The recommended horizontal distance from curb to neck rail is generally 60 to 66 inches (BCMAF, 1994; Cook and Nordlund, 2004). When cows rise, incorrectly installed stationary neck rails can lead to neck injuries (Anderson, 2008b). Movable neck rails, which are usually supported from above, allow cows more freedom when using the stall and may decrease injuries.

Almost all freestall operations (98.2 percent) used neck rails. About 9 of 10 operations (90.5 percent) had stationary neck rails.

a. Percentage of freestall operations by type of neck rail

Type of Neck Rail	Percent Operations	Standard Error
Stationary	90.5	(1.8)
Moveable	7.7	(1.7)
None	1.8	(0.6)
Total	100.0	

Almost one-half of freestall operations that used neck rails placed neck rails at the recommended distance of 60.0 to 65.9 inches from the rear curb. Two-fifths of operations (41.3 percent) placed neck rails at 66.0 or more inches from the rear curb.

b. Percentage of freestall operations that used neck rails, by average distance from neck rail to curb

Average Distance (Inches)	Percent Operations	Standard Error
Less than 60.0	11.9	(2.5)
60.0 to 65.9	46.8	(4.1)
66.0 to 71.9	32.2	(4.0)
72.0 or more	9.1	(2.3)
Total	100.0	

More than three of four freestall operations that used neck rails (77.0 percent) located neck rails at the recommended height of 40.0 to 49.9 inches above the stall bed.

c. Percentage of freestall operations that used neck rails, by average distance from neck rail to bedding surface

Average Distance (Inches)	Percent Operations	Standard Error
Less than 40.0	20.6	(3.2)
40.0 to 45.9	47.6	(4.2)
46.0 to 49.9	29.4	(3.9)
50.0 or more	2.4	(0.9)
Total	100.0	

12. Brisket locators

Brisket locators (or brisket boards) are placed at the front of freestalls to keep cows from lying too far forward in the stall, making it difficult for cows to rise. Brisket locators properly position cows in their stalls and also reduce manure and urine contamination by keeping the rear of the cows close to the curb and alleyway. Brisket locators should be smooth, rounded, and not rise higher than 4 inches above the bedding (Cook and Nordlund, 2004). Research suggests that large wooden brisket locators reduce the time cows spend lying in stalls (Tucker et al., 2006). Stall features that are used to keep cows clean, such as brisket locators, may reduce cow comfort. The recommended distance from the rear curb to the brisket locator is 62 to 72 inches, depending on the weight of the cow being housed (ASABE, 2006).

Brisket locators were present on 59.3 percent of freestall operations. One-third of operations (33.4 percent) used a locator made of wood.

a. Percentage of freestall operations by type of brisket locator

Type of Brisket Locator	Percent Operations	Standard Error
Concrete	4.8	(1.6)
Wood	33.4	(3.9)
PVC or other plastic pipe	12.2	(2.6)
Other	8.9	(2.3)
None	40.7	(3.9)
Total	100.0	

Approximately one of four freestall operations that used brisket locators (22.8 percent) placed them less than 66.0 inches from the rear curb, while about 15 percent of operations placed them 72.0 inches or more from the rear curb.

b. Percentage of freestall operations that used brisket locators by average distance from curb to brisket locator

Average Distance (Inches)	Percent Operations	Standard Error
Less than 66.0	22.8	(4.3)
66.0 to 67.9	25.5	(4.9)
68.0 to 69.9	21.1	(4.6)
70.0 to 71.9	15.7	(3.9)
72.0 or more	14.9	(3.3)
Total	100.0	

13. Lunge space

Lunge space is the area in the front of a stall that allows cows to lunge and bob their heads in order to rise from the lying position. Although this area can be completely open, there is usually some barrier to keep cows from crawling too far forward. Research suggests that barriers should be 40 to 42 inches above the stall surface (Cook and Nordlund, 2004).

More than two of three operations (68.7 percent) had a barrier at the front of stalls. Wood was the barrier material used on 33.9 percent of operations. Approximately one-fourth of operations used "other" materials for front barriers, and the majority of these barriers were combinations of the listed materials as well as metal pipe.

Percentage of freestall operations by lunge barrier material

Lunge Barrier Material	Percent Operations	Standard Error
Concrete	6.6	(2.0)
Wood	33.9	(3.9)
Cable	2.6	(0.9)
Other	25.6	(3.4)
None	31.3	(3.8)
Total	100.0	

14. Curb measures

The curb separates the stall bed from the alleyway. The height of the curb is thought to be more important than its width, since curbs higher than 12.9 inches may lead to udder injuries and cause the cow to be reluctant to step up into the stall. The recommended height for curbs is 8 to 12 inches (BCMAF, 1994). Curb width is considered in the stall-length calculation; if it is excessively wide cows may get hock lesions from the abrasive action of the concrete on the hocks. The recommended curb width is 6 inches (BCMAF, 1994).

Curb height was at the recommended height of 8.0 to 12.9 inches on approximately three of four freestall operations (75.7 percent).

a. Percentage of freestall operations, by curb height

Curb Height (Inches)	**Percent Operations**	**Standard Error**
Less than 8.0	17.7	(3.3)
8.0 to 12.9	75.7	(4.0)
13.0 or more	6.6	(2.8)
Total	100.0	

Almost 70 percent of operations had curb widths of 6.0 to 8.9 inches.

b. Percentage of freestall operations, by curb width

Curb Width (Inches)	**Percent Operations**	**Standard Error**
Less than 6.0	21.6	(3.9)
6.0 to 8.9	68.0	(4.6)
9.0 or more	10.4	(3.1)
Total	100.0	

15. Gutter grates

Gutter grates are found on tie-stall and stanchion operations and have many functions. Grates provide a bridge from the alley to the stall for both cow and human movement. Additionally, grates keep cows' tails out of gutters. Grates are especially important when calves are born in stalls; without grates, calves might be born into the gutter, which might contaminate the calves with manure and urine.

Almost 6 of 10 operations with tie-stall or stanchion housing (55.7 percent) had at least some gutter grates. Approximately one of four operations had gutter grates on less than 50.0 percent of stalls. A higher percentage of tie-stall operations had gutter grates in 50.0 percent or more of stalls than stanchion operations (36.5 and 11.8 percent, respectively).

Percentage operations by percentage of stalls with gutter grates, and by housing type

	Percent Operations					
	Housing Type					
	Tie stall		Stanchion		All Operations	
Percent Stalls with Gutter Grates	Percent	Std. Error	Percent	Std. Error	Percent	Std. Error
0.0	40.6	(5.6)	55.6	(10.1)	44.3	(4.8)
0.1 to 49.9	22.9	(4.9)	32.6	(9.5)	25.3	(4.3)
50.0 or more	36.5	(5.4)	11.8	(6.5)	30.4	(4.5)
Total	100.0		100.0		100.0	

16. Cow trainers

Cow trainers should be located about 4 inches above the withers and are used to help keep the stall bed clean. When cows arch their backs to urinate or defecate, cow trainers prompt the cows to back up and deposit in the gutter instead of the stall bed. To be most effective, trainers must be adjusted for each cow. It appears that trainers need to be activated only 1 to 2 days per week to have the desired effect (Anderson, 2008a). Although trainers are supposed to assist in keeping stalls and cows cleaner, one study found that the presence of electric trainers was associated with dirty hind limbs and more cows with open wounds of the hock (Zurbrigg et al., 2005).

A higher percentage of tie-stall operations had electric cow trainers compared with stanchion operations (72.6 and 42.8 percent, respectively).

a. Percentage operations with cow trainers, by housing type

Percent Operations					
Housing Type					
Tie stall		Stanchion		All Operations	
Percent	Std. Error	Percent	Std. Error	Percent	Std. Error
72.6	(4.8)	42.8	(9.7)	65.0	(4.3)

The horizontal distance from the trainer to the edge of the gutter should be approximately 48 inches (Anderson, 2008a). On approximately 45 percent of tie-stall operations, trainers were located 50.0 inches or more from the gutter edge, while on nearly the same percentage of stanchion operations, the trainer was located less than 46.0 inches from the gutter edge.

b. Percentage of operations by operation horizontal distance from trainer to gutter, and by housing type

	Percent Operations					
	Housing Type					
	Tie stall		Stanchion		All Operations	
Average Horizontal Distance (Inches)	Percent	Std. Error	Percent	Std. Error	Percent	Std. Error
Less than 46.0	17.0	(4.9)	41.9	(15.6)	21.2	(5.1)
46.0 to 49.9	37.5	(6.7)	30.8	(13.8)	36.3	(6.1)
50.0 to 53.9	23.0	(5.7)	18.2	(10.1)	22.2	(5.1)
54.0 or more	22.5	(5.5)	9.1	(8.7)	20.3	(4.8)
Total	100.0		100.0		100.0	

The height of a cow trainer should be directly related to the height of the cow, with the trainer being 4 inches above the back/wither area (Anderson, 2008a). Approximately one-fourth of all operations located the trainers less than 58.0 inches from the stall bed and almost two-fifths located trainers at 60.0 inches or more above the stall bed.

c. Percentage of operations by average distance from trainer to bed, and by housing type

	Percent Operations					
	Housing Type					
	Tie stall		Stanchion		All Operations	
Average Distance (Inches)	Percent	Std. Error	Percent	Std. Error	Percent	Std. Error
Less than 58.0	26.6	(5.8)	36.4	(15.1)	28.2	(5.5)
58.0 to 59.9	35.4	(6.7)	26.6	(13.5)	33.9	(6.1)
60.0 or more	38.0	(6.7)	37.0	(14.4)	37.9	(6.0)
Total	100.0		100.0		100.0	

17. Water sources

Approximately 9 of 10 operations provided water troughs or tanks to cows in freestall or other multiple-animal area housing types, including dry lots.

Percentage of operations by water source and by housing type

	Percent Operations					
	Housing Type					
	Freestall		Other Multiple-animal Area		All Operations	
Water Source	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Individual cups or bowls	0.6	(0.4)	0.0	(--)	0.5	(0.3)
Troughs or tanks	91.2	(2.5)	91.6	(3.7)	91.3	(2.1)
Other	1.0	(1.0)	3.9	(2.8)	1.6	(1.0)
Combination of above	7.2	(2.3)	4.5	(2.4)	6.6	(1.9)
Total	100.0		100.0		100.0	

B. Cow Health

Note: Differences in this section were analyzed using STATA and the SUDAAN software. P values less than 0.05 were considered statistically significant (see Section III: Methodology, p 156).

1. Cow morbidity

During 2006, clinical mastitis, lameness, and infertility were the most common problems affecting cows on assessed operations (16.6, 16.0, and 14.9 percent of cows, respectively). A higher percentage of cows on tie-stall and freestall operations experienced clinical mastitis, infertility, or a displaced abomasum compared with cows in other housing types. Lameness affected the highest percentage of cows on freestall operations (18.4 percent) compared with cows in other housing types. With the exception of tie-stall operations, infertility was highest on freestall operations compared with other housing types.

Percentage of cows by health problems in 2006 and by housing type

	Percent Cows*													
	Housing Type													
	Tie stall		Stanchion		Freestall		Dry lot		Other Multiple-animal Area		All Assessed Operations		All Dairy 2007 Operations	
Problem	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Clinical mastitis	18.6	(1.4)	14.0	(1.5)	17.9	(1.1)	10.5	(2.2)	10.3	(1.8)	16.6	(0.8)	16.5	(0.5)
Lameness	14.3	(1.4)	12.9	(2.5)	18.4	(1.2)	7.9	(1.9)	11.0	(3.1)	16.0	(0.8)	14.0	(0.4)
Respiratory problems	4.8	(1.1)	3.5	(1.5)	3.9	(0.3)	2.0	(0.3)	2.1	(0.4)	3.7	(0.3)	3.3	(0.1)
Retained placenta (more than 24 hours)	10.3	(0.8)	8.5	(1.4)	9.2	(0.5)	3.9	(0.8)	5.8	(1.3)	8.7	(0.4)	7.8	(0.2)
Infertility problems (not pregnant 150 days after calving)	14.1	(1.1)	8.6	(1.3)	16.4	(1.0)	11.0	(1.5)	11.5	(1.6)	14.9	(0.7)	12.9	(0.3)
Other reproductive problems (e.g., dystocia, metritis)	5.0	(0.7)	4.2	(1.3)	7.8	(1.0)	2.0	(0.5)	6.4	(1.2)	6.6	(0.7)	4.6	(0.3)
Diarrhea for more than 48 hours	4.7	(1.8)	5.2	(2.2)	1.9	(0.2)	2.0	(1.0)	1.5	(0.2)	2.4	(0.3)	2.5	(0.2)
Milk fever	8.0	(0.8)	7.8	(2.2)	5.1	(0.4)	3.1	(0.5)	2.7	(0.4)	5.3	(0.3)	4.9	(0.1)
Displaced abomasum	5.0	(0.4)	3.7	(0.7)	4.3	(0.3)	1.4	(0.3)	3.0	(0.6)	4.0	(0.2)	3.5	(0.1)
Neurological problems	0.6	(0.2)	0.2	(0.1)	0.3	(0.1)	0.1	(0.1)	0.6	(0.2)	0.3	(0.1)	0.3	(0.0)
Other health-related problems	0.7	(0.4)	0.8	(0.7)	1.5	(0.6)	1.0	(0.9)	0.3	(0.2)	1.2	(0.4)	0.6	(0.1)

*As a percentage of January 1, 2007, cow inventory.

2. Permanently removed cows

During 2006, udder or mastitis problems, lameness or injury, and reproductive problems each accounted for more than 4 percent of the cow inventory permanently removed on all assessed operations. A higher percentage of cows on tie-stall operations were sold as replacements to other dairies compared with cows in other housing types, except other multiple-animal areas. A higher percentage of cows were removed from tie-stall operations (27.8 percent) compared with cows on stanchion or freestall operations (18.5 and 24.0 percent, respectively). Freestall operations removed a higher percentage of cows than stanchion operations.

For operations that permanently removed cows in 2006, percentage of cows permanently removed, by reason and by housing type

	Percent Cows*											
	Housing Type											
	Tie stall		Stanchion		Freestall		Dry lot		Other Multiple-animal Area		All Assessed Operations		All Dairy 2007 Operations	
Reason	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Udder or mastitis problems	7.1	(0.6)	5.6	(0.9)	5.5	(0.4)	4.9	(1.1)	5.8	(1.3)	5.6	(0.3)	5.4	(0.1)
Lameness or injury	5.0	(0.6)	3.3	(0.6)	4.3	(0.3)	3.0	(0.7)	4.5	(1.3)	4.2	(0.3)	3.8	(0.1)
Reproductive problems	7.3	(0.7)	5.2	(0.7)	7.2	(0.5)	7.4	(1.8)	6.7	(1.3)	7.1	(0.4)	6.2	(0.2)
Poor production not related to above	2.7	(0.4)	2.3	(0.8)	3.2	(0.5)	3.5	(1.3)	5.5	(1.0)	3.3	(0.4)	3.8	(0.2)
Aggressiveness or belligerence	0.2	(0.1)	0.7	(0.3)	0.1	(0.0)	0.1	(0.1)	0.5	(0.4)	0.2	(0.0)	0.1	(0.0)
Other diseases	1.0	(0.2)	0.7	(0.4)	1.2	(0.2)	1.2	(0.6)	0.2	(0.2)	1.1	(0.1)	0.9	(0.1)
Sold as replacements to another dairy	3.7	(1.4)	0.1	(0.1)	0.9	(0.2)	0.4	(0.3)	2.8	(1.7)	1.4	(0.3)	1.4	(0.2)
Other	0.8	(0.3)	0.6	(0.4)	1.6	(0.6)	0.5	(0.2)	0.6	(0.4)	1.3	(0.4)	2.0	(0.3)
Total	27.8	(1.6)	18.5	(1.6)	24.0	(0.9)	21.0	(4.0)	26.6	(3.1)	24.2	(0.8)	23.6	(0.4)

*As a percentage of January 1, 2007, cow inventory.

3. Cow mortality

Deaths due to lameness or injury, mastitis, and calving problems each accounted for 1 percent or more of the cow inventory on all assessed operations. A lower percentage of cow deaths due to digestive problems (0.2 percent) occurred on tie-stall operations than on freestall or other multiple-animal areas (0.7 and 1.1 percent, respectively). Mastitis accounted for a higher percentage of cow deaths on freestall operations and operations with other multiple-animal area housing than on stanchion operations. Cow deaths due to calving problems were lowest for cows on stanchion operations compared with all other operations, with the exception of operations with other multiple-animal areas.

Percentage of cow deaths by cause and by housing type

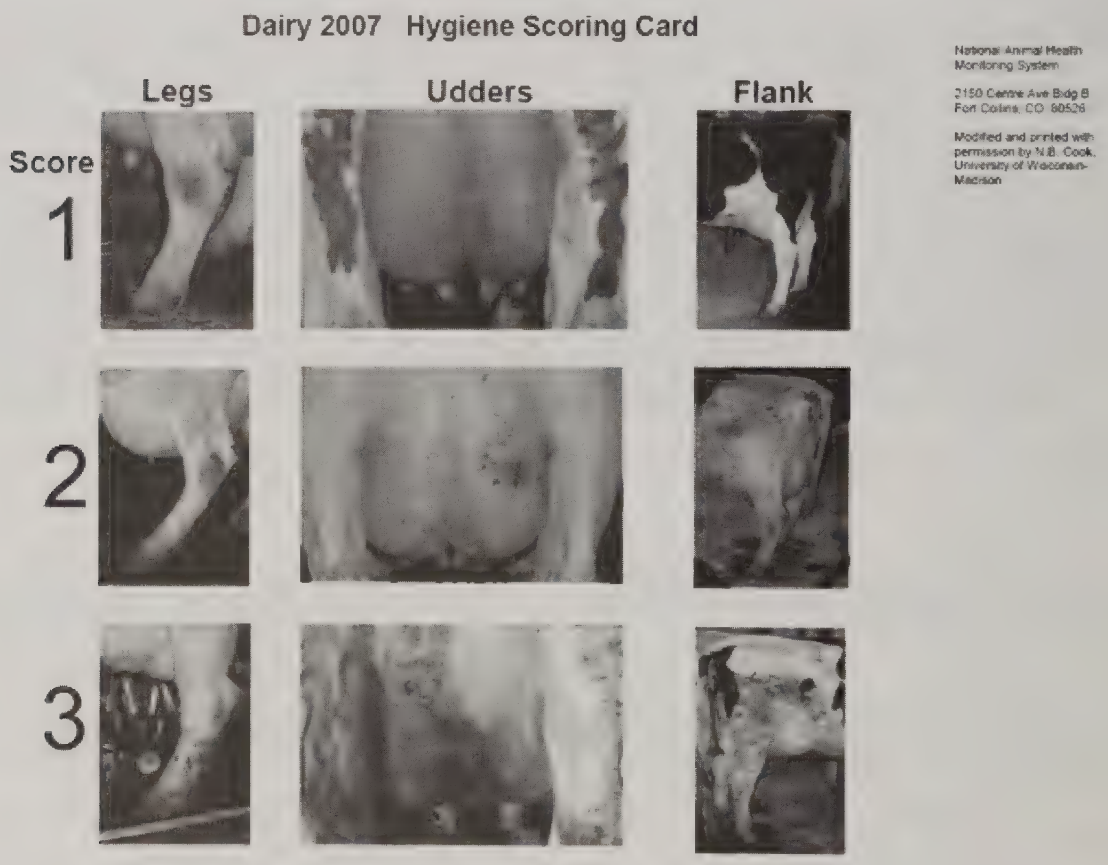
	Percent Cows*											
	Housing Type											
	Tie stall		Stanchion		Freestall		Dry lot		Other Multiple-animal Area		All Assessed Operations		All Dairy 2007 Operations	
Cause	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Scours, diarrhea, or other digestive problems	0.2	(0.1)	0.5	(0.3)	0.7	(0.1)	0.9	(0.4)	1.1	(0.4)	0.7	(0.1)	0.6	(0.0)
Respiratory problems	0.4	(0.2)	0.3	(0.2)	0.7	(0.1)	0.5	(0.1)	0.5	(0.1)	0.6	(0.1)	0.6	(0.0)
Poison	0.0	(--)	0.0	(--)	0.0	(--)	0.1	(0.1)	0.0	(--)	0.0	(0.0)	0.0	(0.0)
Lameness or injury	1.2	(0.2)	0.6	(0.3)	1.3	(0.1)	0.7	(0.2)	1.3	(0.2)	1.2	(0.1)	1.1	(0.0)
Lack of coordination or severe depression	0.1	(0.0)	0.3	(0.3)	0.1	(0.0)	0.0	(--)	0.0	(--)	0.1	(0.0)	0.0	(0.0)
Mastitis	0.7	(0.2)	0.5	(0.2)	1.2	(0.1)	0.7	(0.3)	1.4	(0.4)	1.1	(0.1)	0.9	(0.0)
Calving problems	1.4	(0.3)	0.3	(0.1)	1.0	(0.1)	0.9	(0.3)	0.6	(0.2)	1.0	(0.1)	0.9	(0.0)
Other known reasons	0.7	(0.2)	0.7	(0.3)	0.7	(0.1)	1.7	(0.7)	0.4	(0.2)	0.7	(0.1)	0.6	(0.0)
Unknown reasons	0.9	(0.2)	1.1	(0.5)	1.0	(0.1)	0.5	(0.2)	0.4	(0.1)	0.9	(0.1)	0.8	(0.1)
Total	5.6	(0.5)	4.3	(0.7)	6.7	(0.3)	6.0	(1.1)	5.7	(0.5)	6.3	(0.2)	5.7	(0.1)

*As a percentage of January 1, 2007, cow inventory.

C. Cow Assessments

1. Background/ method

Operations participating in Phase II (VMO component) of the Dairy 2007 study were given the opportunity to have up to 100 cows evaluated for hygiene of the udder, legs, and flanks. Hygiene was scored on a scale from 1 to 3, with 1 being no or very little manure and 3 being manure present in large quantities on the udder, legs, and flanks. Assessments were completed between March 5 and September 5, 2007. A training video was produced to assist evaluators in conducting the animal assessments. The following photographs of hygiene and hocks were provided to assist scorers in evaluating cows.



Hygiene is a critical component of producing quality milk. Multiple studies have shown a relationship between udder hygiene and somatic cell counts (Schriener and Ruegg, 2003; Reneau et al., 2005). Increased bacterial counts in milk have also been associated with poor udder hygiene (Elmoslemany et al., 2009). Hygiene is impacted by stall design and manure management. Cows on operations with properly designed and maintained freestalls and alleyways are more likely to have better hygiene than cows housed in improperly designed or maintained facilities.

Operations were also given the opportunity to have up to 100 cows scored for hock condition. Hocks were scored on a scale from 1 to 3, with 1 indicating hocks with no swelling or hair loss and 3 indicating hocks with evident swelling or a lesion through the hide. Each cow received two hock scores, one for each rear leg, and the higher of the hock scores was applied to the cow (i.e., if a cow had hair loss on one hock [score=2] and not the other [score=1] the cow received a score of 2). The following chart was used to evaluate hocks.

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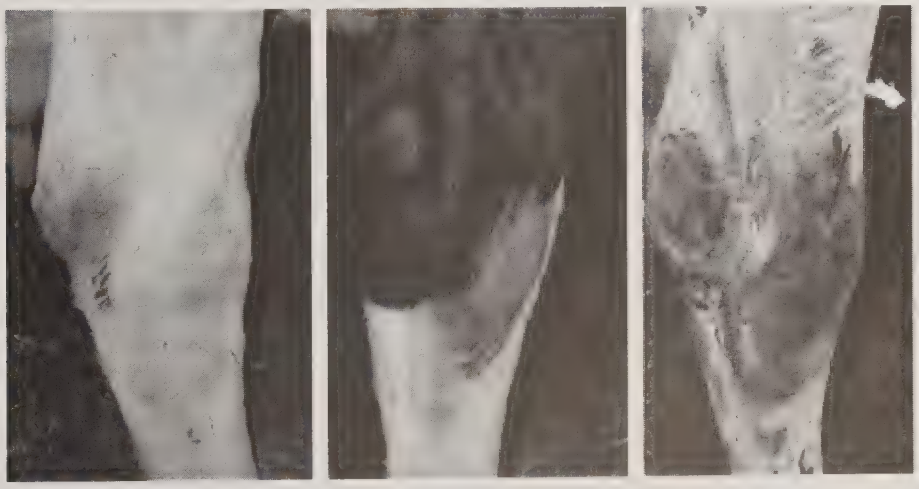
Hock Assessment Chart for Cattle



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Score = 1
No Swelling. No hair is missing

Score = 2
No swelling. Bald area on the hock

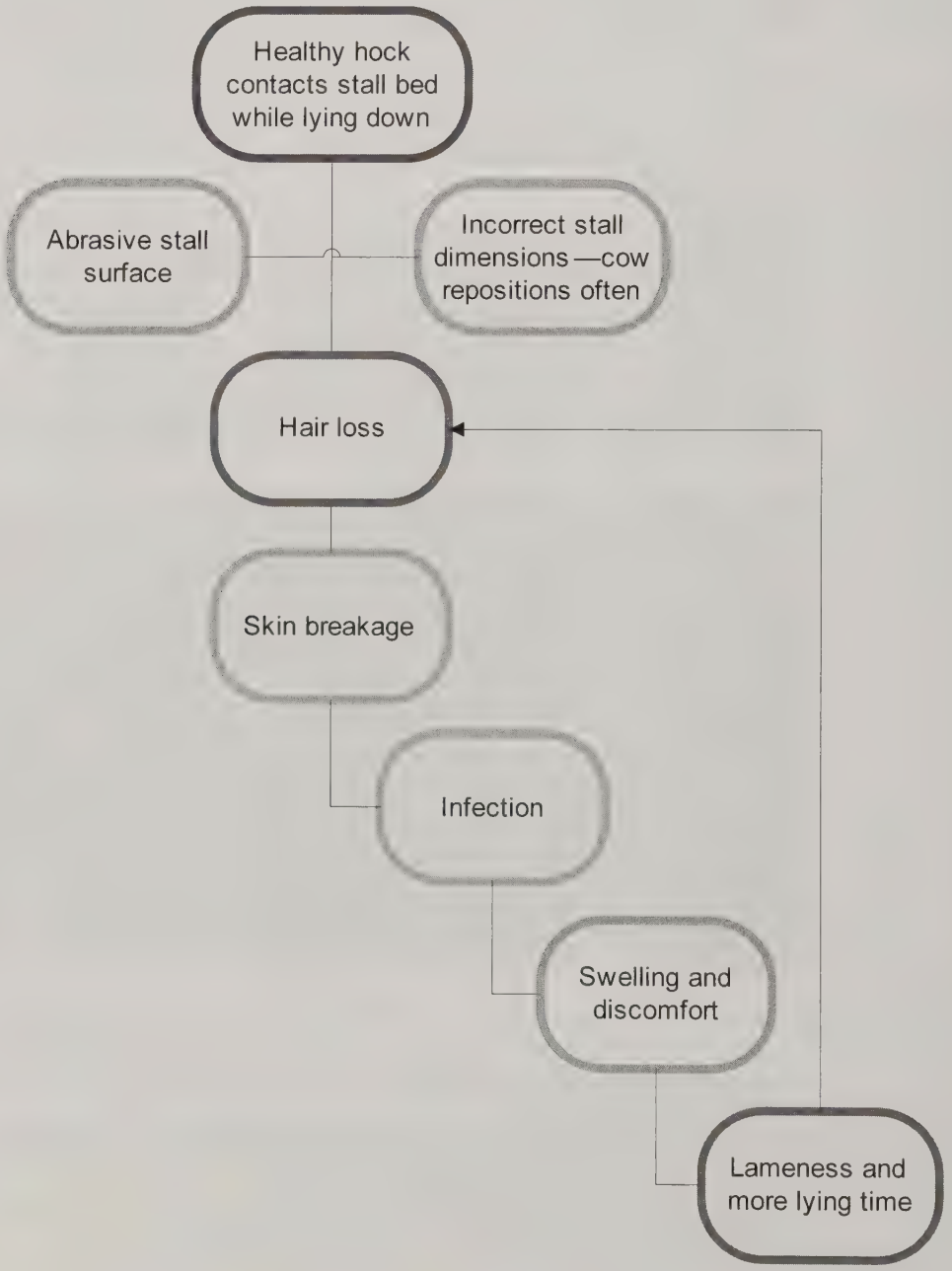
Score = 3
Swelling is evident or there is a lesion through the hide

The normal, healthy hock is free from skin lesions and swelling. Ideally, the hair coat in that area is smooth and continuous with the rest of the leg.

Hock health is an important indicator of the abrasiveness of stall bedding and cow comfort. Injury is usually the result of prolonged exposure to an abrasive stall surface. Skin breakage provides an opportunity for infection to occur, which can lead to swelling, discomfort, and possibly lameness.

A consistent method of scoring hocks for swelling and hair loss allows you to assess the need to modify your stall management and can help you evaluate the effect of management changes.

The following chart outlines a hypothetical sequence of events that might lead to the development of hock lesions (Vokey, 2004). Most hock lesions are secondary to contact with abrasive surfaces. Continued exposure to abrasive surfaces leads to hair loss, skin abrasions, infection, and subsequent swelling and lameness.



Facility and management features associated with increased hock lesions include stall surface materials and stall design. Multiple studies have reported that rubber-filled mattresses are associated with more hock lesions compared with most other stall bases (Weary and Taszkun, 2000; Wechsler et al., 2000; Vokey et al., 2001; Fulwider et al., 2007). Short stall length may also contribute to more hock lesions (Weary and Taszkun, 2000).

2. Hygiene results

Note: Differences in this section were analyzed using STATA and SUDAAN software. P values less than 0.05 were considered statistically significant (see Section III: Methodology, p 156).

Hygiene scoring was performed on 477 operations. Freestall operations accounted for 282 of these operations and provided the majority (68.3 percent) of all cows scored. Approximately twice as many cows were scored on freestall, dry lot, and other multiple-animal area operations than on tie-stall or stanchion operations. These differences in animals scored among different housing types are directly related to herd size.

a. Number of operations assessed and number of cows assigned hygiene scores, by housing type

	Housing Type					
Parameter	Tie stall	Stanchion	Freestall	Dry lot	Other Multiple-animal Area	All Operations
Total number of operations assessed	102	27	282	30	36	477
Total number of cows scored	5,576	1,236	26,782	2,551	3,051	39,196
Average number of cows scored per operation	54.7	45.8	95.0	85.0	84.7	82.2

Among all housing types, 39.5 percent of cows had a hygiene score of 2 and 13.9 percent had a score of 3. Overall, there were no differences across housing types in the percentages of cows with hygiene scores of 1. A lower percentage of cows on freestall operations (10.0 percent) had a hygiene score of 3 compared with cows on tie-stall, stanchion, and dry lot operations (16.2, 21.4, and 22.3 percent, respectively).

b. Percentage of cows by hygiene score and by housing type

	Percent Cows											
	Housing Type											
	Tie stall		Stanchion		Freestall		Dry lot		Other Multiple-animal Area		All Operations	
Hygiene Score	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
1	48.6	(2.9)	37.3	(5.6)	47.9	(2.3)	43.7	(6.1)	42.3	(6.5)	46.6	(1.7)
2	35.2	(1.7)	41.3	(4.5)	42.1	(1.9)	34.0	(3.3)	43.7	(6.8)	39.5	(1.3)
3	16.2	(1.6)	21.4	(2.8)	10.0	(1.1)	22.3	(4.5)	14.0	(3.8)	13.9	(0.9)
Total	100.0		100.0		100.0		100.0		100.0		100.0	

Operations that used stall bases made of concrete or rubber mats had a higher percentage of cows with hygiene scores of 3 (16.5 and 18.0 percent, respectively) than operations that used dirt or mattresses (10.2 and 11.6 percent, respectively).

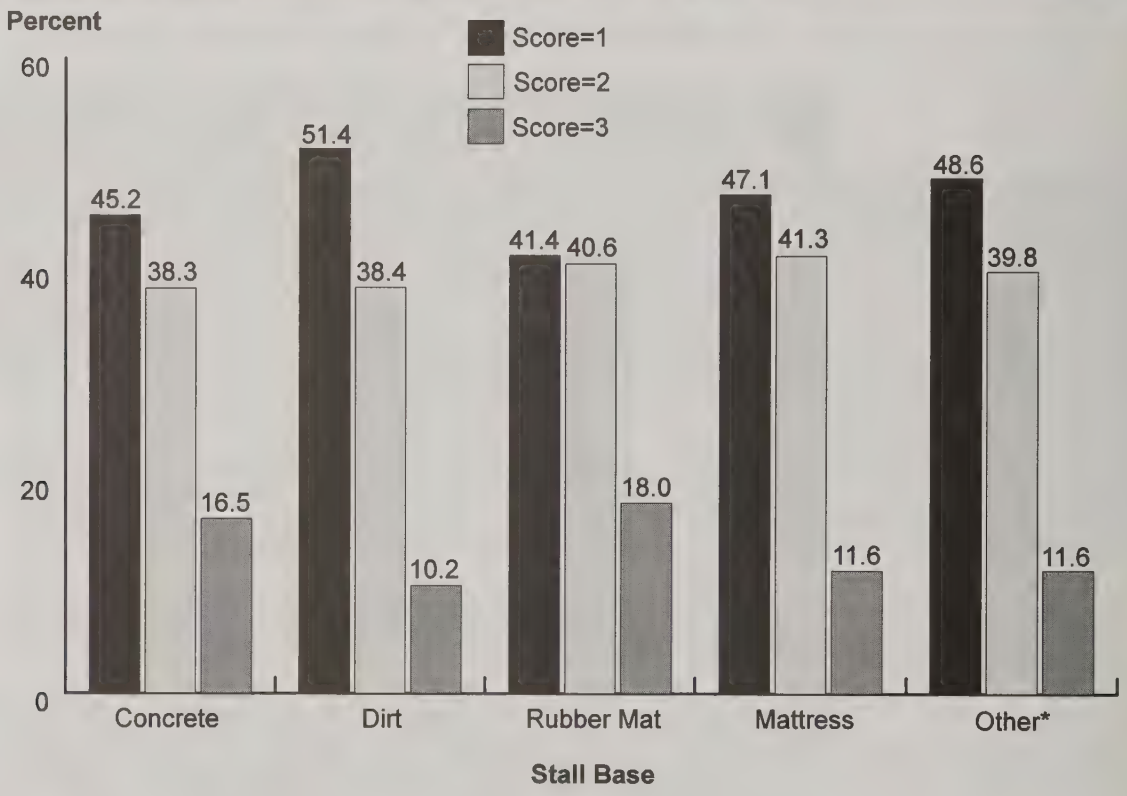
c. Percentage of cows by hygiene score and by type of stall base

	Percent Cows									
	Type of Stall Base									
	Concrete		Dirt		Rubber Mat		Mattress		Other*	
Hygiene Score	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
1	45.2	(3.3)	51.4	(3.7)	41.4	(3.3)	47.1	(3.3)	48.6	(5.0)
2	38.3	(2.2)	38.4	(3.3)	40.6	(2.4)	41.3	(2.8)	39.8	(4.1)
3	16.5	(1.9)	10.2	(1.5)	18.0	(2.2)	11.6	(1.2)	11.6	(2.5)
Total	100.0		100.0		100.0		100.0		100.0	

*Includes waterbeds.

Photo courtesy of Dr. Jason Lombard

Percentage of Cows by Hygiene Score and by Stall Base



*Includes waterbeds.

Bedding type influenced hygiene scores. The lowest percentage of cows with a hygiene score of 3 were on operations that bedded stalls with coarse sand, composted manure, or dried manure (primarily freestall operations).

d. Percentage of cows by hygiene score and by bedding type

Percent Cows

Bedding Type

Hygiene Score	Straw		Sawdust		Fine Sand		Coarse Sand		Composted Manure		Dried Manure		Other*		None	
	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
1	48.5	(2.8)	48.2	(3.4)	42.9	(4.7)	51.1	(6.0)	60.7	(8.2)	50.3	(10.3)	40.6	(4.4)	37.5	(6.7)
2	37.0	(2.0)	36.7	(2.5)	43.5	(3.6)	41.5	(5.3)	34.8	(6.8)	43.3	(10.6)	43.1	(3.1)	41.8	(3.5)
3	14.5	(1.6)	15.1	(1.8)	13.6	(2.8)	7.4	(1.6)	4.5	(2.3)	6.4	(2.2)	16.3	(2.2)	20.7	(4.2)
Total	100.0		100.0		100.0		100.0		100.0		100.0		100.0		100.0	

*Includes shredded newspaper.

Days since bedding was added/changed was not significantly associated with the percentage of cows by hygiene score.

e. Percentage of cows by hygiene score and by number of days since bedding was added/changed

Percent Cows

Number of Days

Hygiene Score	Less than 1		1–2		3–4		5–6		7 or More	
	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
1	45.5	(7.1)	46.1	(3.5)	40.4	(5.6)	50.0	(5.4)	52.1	(4.1)
2	41.6	(4.9)	40.2	(2.8)	46.1	(4.7)	38.9	(3.9)	37.7	(2.9)
3	12.9	(3.0)	13.7	(2.0)	13.5	(3.1)	11.1	(3.2)	10.2	(1.8)
Total	100.0		100.0		100.0		100.0		100.0	

As bedding quantity/stall condition decreased, the percentage of cows with a hygiene score of 3 increased.

f. Percentage of cows by hygiene score and by bedding quantity/stall condition in majority of stalls

	Percent Cows									
	Bedding Quantity/Stall Condition									
	Base not Exposed, Bedding Level with Curb		Base not Exposed, Bedding Slightly Dished Out		Base Exposed (Less than 50 Percent)		Base Mostly Exposed (More than 50 Percent)		No Bedding Present*	
Hygiene Score	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
1	51.3	(4.6)	50.4	(3.1)	41.2	(2.9)	45.5	(3.4)	39.3	(6.1)
2	40.4	(4.2)	37.6	(2.4)	43.2	(2.2)	37.6	(2.6)	40.5	(3.1)
3	8.3	(2.2)	12.0	(1.5)	15.6	(1.7)	16.9	(1.7)	20.2	(4.0)
Total	100.0		100.0		100.0		100.0		100.0	

*80.9 percent of operations on which no bedding was present were dry lot operations or operations with other multiple-animal areas.

Platform lengths for stalls on tie-stall and stanchion operations were not associated with hygiene scores.

g. For tie-stall and stanchion operations, percentage of cows by hygiene score and by average platform length

	Percent Cows									
	Average Platform Length (Inches)									
	Less than 60.0		60.0–64.9		65.0–69.9		70.0–74.9		75.0 or More	
Hygiene Score	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
1	41.1	(7.3)	40.8	(7.2)	46.9	(4.1)	51.5	(3.5)	41.4	(14.1)
2	40.7	(5.4)	37.3	(5.3)	36.1	(2.1)	34.7	(2.2)	42.7	(10.1)
3	18.2	(5.8)	21.9	(3.2)	17.0	(2.7)	13.8	(1.7)	15.9	(4.5)
Total	100.0		100.0		100.0		100.0		100.0	

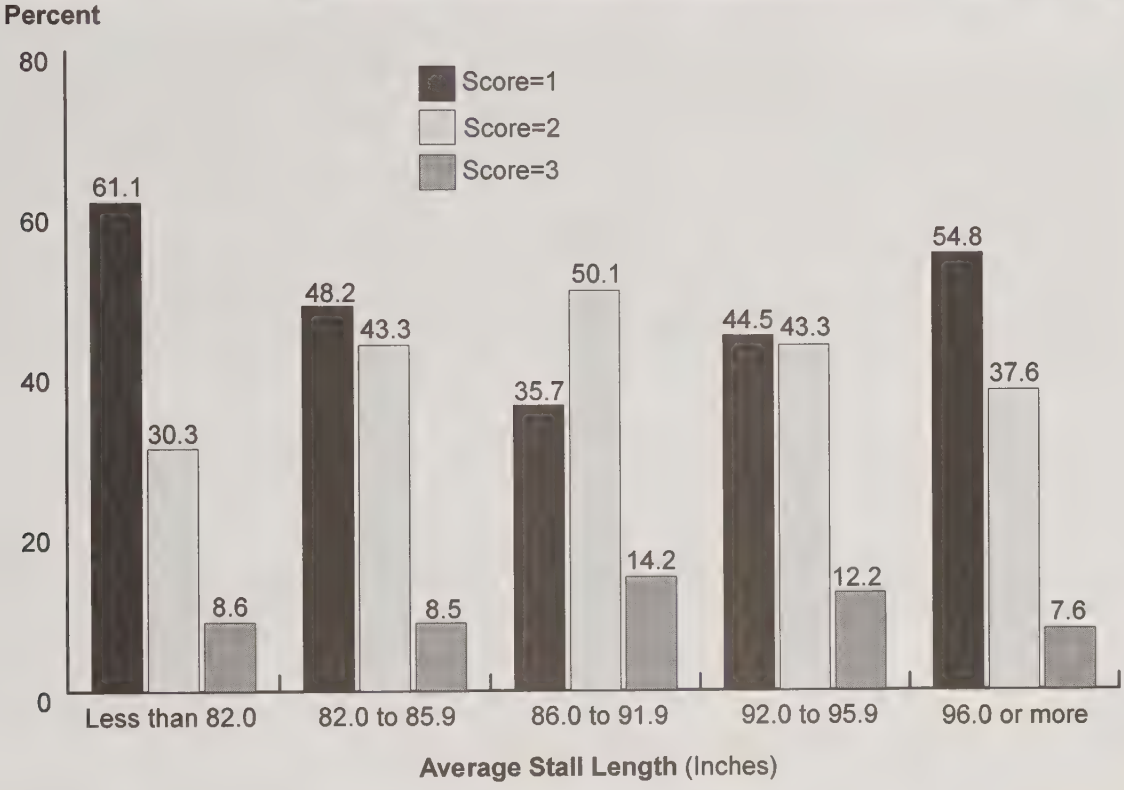
Photo courtesy of Dr. Jason Lombard

Freestall operations with stall lengths of less than 82.0 inches or 96.0 inches or more had a higher percentage of cows with a hygiene score of 1 (61.1 and 54.8 percent, respectively) compared with freestall operations with stall lengths of 86.0 to 91.9 inches (35.7 percent).

h. For freestall operations, percentage of cows by hygiene score and by average stall length

	Percent Cows									
	Average Stall Length (Inches)									
	Less than 82.0		82.0–85.9		86.0–91.9		92.0–95.9		96.0 or More	
Hygiene Score	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
1	61.1	(7.6)	48.2	(6.0)	35.7	(3.7)	44.5	(6.9)	54.8	(7.6)
2	30.3	(5.5)	43.3	(5.2)	50.1	(3.2)	43.3	(5.1)	37.6	(6.9)
3	8.6	(4.6)	8.5	(2.3)	14.2	(2.6)	12.2	(2.3)	7.6	(1.7)
Total	100.0		100.0		100.0		100.0		100.0	

For Freestall Operations, Percentage of Cows by Hygiene Score and by Average Stall Length



The width of stalls did not have an impact on hygiene scores.

i. Percentage of cows by hygiene score and by average stall width

	Percent Cows											
	Average Stall Width (Inches)											
	Less than 42.0		42.0–43.9		44.0–45.9		46.0–47.9		48.0–49.9		50.0 or More	
Hygiene Score	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
1	45.6	(6.6)	38.2	(5.9)	48.1	(4.5)	46.4	(3.6)	43.2	(5.0)	52.9	(6.3)
2	36.1	(3.6)	44.1	(4.8)	39.7	(3.4)	41.6	(2.8)	38.4	(3.7)	34.4	(3.0)
3	18.3	(3.9)	17.7	(4.4)	12.2	(2.4)	12.0	(1.6)	18.4	(2.3)	12.7	(4.0)
Total	100.0		100.0		100.0		100.0		100.0		100.0	

A higher percentage of cows on operations with moveable neck rails had a hygiene score of 1 (74.8 percent) compared with cows on operations with stationary neck rails or no neck rails (43.7 and 40.8 percent, respectively).

j. For freestall operations, percentage of cows by hygiene score and by type of neck rail

	Percent Cows					
	Type of Neck Rail					
	Stationary		Moveable		None	
Hygiene Score	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
1	43.7	(2.3)	74.8	(6.1)	40.8	(8.5)
2	45.2	(2.0)	20.3	(4.5)	45.7	(9.6)
3	11.1	(1.2)	4.9	(2.5)	13.5	(7.0)
Total	100.0		100.0		100.0	

The forward location of the neck rail was not associated with the percentage of cows by hygiene score.

k. For freestall operations, percentage of cows by hygiene score and by average distance from neck rail to curb

	Percent Cows							
	Average Distance (Inches)							
	Less than 60.0		60.0–65.9		66.0–71.9		72.0 or More	
Hygiene Score	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
1	47.1	(8.1)	49.1	(3.2)	44.2	(4.0)	50.3	(6.6)
2	42.3	(6.5)	40.6	(2.6)	45.1	(3.4)	40.1	(6.1)
3	10.6	(3.4)	10.3	(1.8)	10.7	(1.7)	9.6	(1.9)
Total	100.0		100.0		100.0		100.0	

The distance of the neck rail above the bedding surface was not associated with the percentage of cows by hygiene score.

l. For freestall operations, percentage of cows by hygiene score and by average distance from neck rail to bedding surface

	Percent Cows							
	Average Distance (Inches)							
	Less than 40.0		40.0–45.9		46.0–49.9		50.0 or More	
Hygiene Score	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
1	56.8	(5.0)	42.4	(3.1)	48.6	(4.6)	46.4	(10.0)
2	32.5	(3.8)	47.2	(2.7)	41.4	(3.5)	42.5	(7.9)
3	10.7	(3.3)	10.4	(1.2)	10.0	(2.0)	11.1	(4.1)
Total	100.0		100.0		100.0		100.0	

Operations with wood brisket locators had a higher percentage of cows with scores of 3 (12.3 percent) compared with operations that used "other" materials for brisket locators or did not use brisket locators.

m. For freestall operations, percentage of cows by hygiene score and by type of brisket locator

Percent Cows

	Type of Brisket Locator									
	Concrete		Wood		PVC or Other Plastic Pipe		Other		None	
Hygiene Score	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
1	46.0	(11.1)	41.0	(3.4)	43.8	(6.3)	56.2	(6.7)	51.9	(3.9)
2	29.2	(7.1)	46.7	(2.9)	45.7	(5.6)	39.0	(5.7)	39.7	(3.1)
3	24.8	(11.5)	12.3	(1.8)	10.5	(2.8)	4.8	(1.1)	8.4	(1.3)
Total	100.0		100.0		100.0		100.0		100.0	

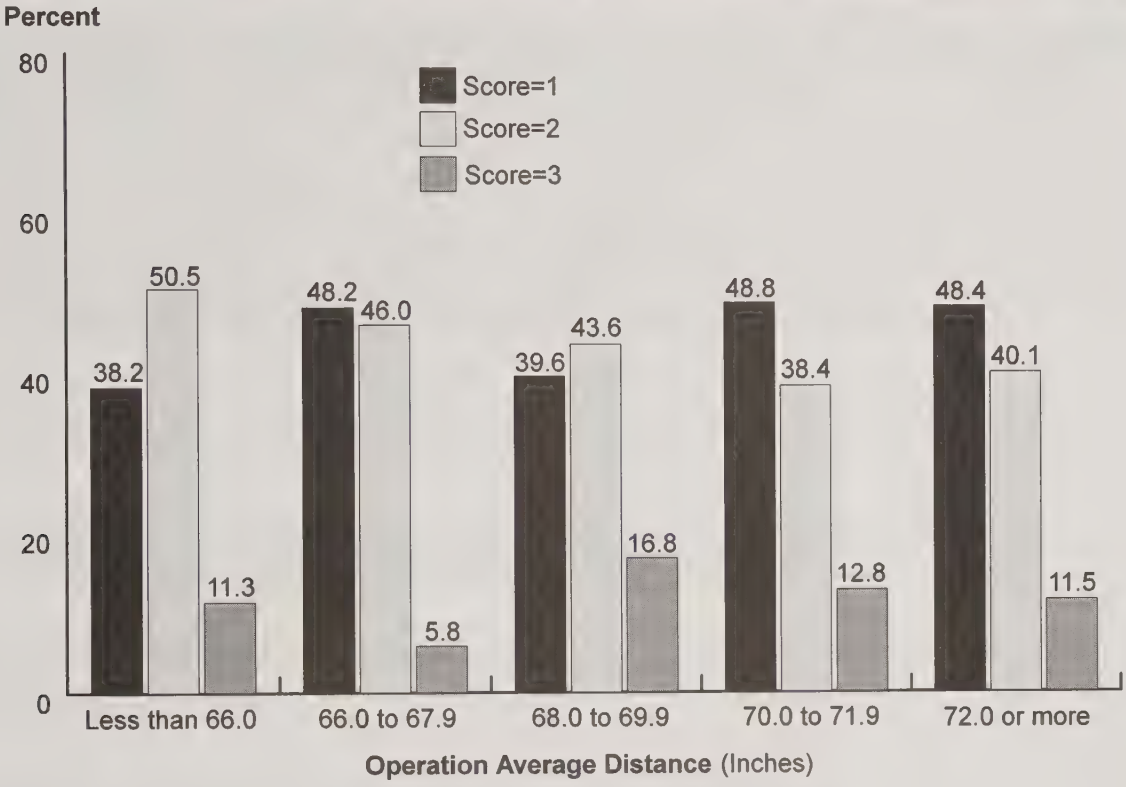
The percentage of cows with hygiene scores of 3 was significantly lower when the distance from the curb to the brisket locator was 66.0 to 67.9 inches than when the distance was less than 66.0 inches and 68.0 to 69.9 inches.

n. For freestall operations, percentage of cows by hygiene score and by operation average distance form curb to brisket locator

Percent Cows

	Operation Average Distance (Inches)									
	Less than 66.0		66.0–67.9		68.0–69.9		70.0–71.9		72.0 or More	
Hygiene Score	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
1	38.2	(4.7)	48.2	(5.4)	39.6	(5.3)	48.8	(8.0)	48.4	(7.7)
2	50.5	(4.5)	46.0	(4.5)	43.6	(4.0)	38.4	(6.5)	40.1	(6.1)
3	11.3	(2.3)	5.8	(1.1)	16.8	(5.4)	12.8	(3.8)	11.5	(3.4)
Total	100.0		100.0		100.0		100.0		100.0	

For Freestall Operations, Percentage of Cows by Hygiene Score and by Operation Average Distance from Curb to Brisket Locator



The presence of a lunge barrier or type of barrier was not associated with hygiene scores.

o. For freestall operations, percentage of cows by hygiene score and by lunge barrier material

	Percent Cows									
	Lunge Barrier Material									
	Concrete		Wood		Cable		Other		None	
Hygiene Score	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
1	47.8	(9.1)	49.9	(3.6)	40.9	(7.9)	45.1	(5.0)	47.7	(4.2)
2	44.8	(7.5)	39.0	(2.8)	49.0	(7.0)	44.5	(4.4)	41.8	(3.2)
3	7.4	(1.8)	11.1	(1.8)	10.1	(3.2)	10.4	(2.7)	10.5	(1.8)
Total	100.0		100.0		100.0		100.0		100.0	

A lower percentage of cows were assigned a hygiene score of 1 on operations with curb heights of 13 inches or more (31.6 percent) compared with cows on operations with curb heights of 8.0 to 12.9 inches.

p. For freestall operations, percentage of cows by hygiene score and by curb height

	Percent Cows					
	Curb Height (Inches)					
	Less than 8.0		8.0–12.9		13.0 or More	
Hygiene Score	Percent	Std. Error	Percent	Std. Error	Percent	Std. Error
1	47.3	(5.7)	48.8	(2.7)	31.6	(5.6)
2	42.1	(5.0)	40.9	(2.1)	56.3	(5.0)
3	10.6	(3.0)	10.3	(1.3)	12.1	(2.4)
Total	100.0		100.0		100.0	

Curb width did not influence cow hygiene scores.

q. For freestall operations, percentage of cows by hygiene score and by curb width

	Percent Cows					
	Curb Width (Inches)					
	Less than 6.0		6.0–8.9		9.0 or More	
Hygiene Score	Percent	Std. Error	Percent	Std. Error	Percent	Std. Error
1	49.3	(5.8)	50.1	(3.4)	56.3	(7.5)
2	42.8	(5.2)	39.7	(2.7)	31.3	(4.3)
3	7.9	(1.8)	10. 2	(1.6)	12.4	(5.8)
Total	100.0		100.0		100.0	

Operations with any gutter grates had a higher percentage of cows assigned a hygiene score of 1 compared with operations without gutter grates. For operations on which 50.0 percent or more of stalls had gutter grates, a lower percentage of cows received a hygiene score of 3 compared with operations without gutter grates (12.8 and 21.4 percent of cows, respectively).

r. For tie-stall and stanchion operations, percentage of cows by hygiene score and by percentage of stalls with gutter grates

	Percent Cows					
	Percent Stalls with Gutter Grates					
	0.0		0.1–49.9		50.0 or More	
Hygiene Score	Percent	Std. Error	Percent	Std. Error	Percent	Std. Error
1	38.2	(4.7)	50.9	(4.1)	54.0	(3.6)
2	40.4	(3.2)	33.2	(2.2)	33.2	(2.2)
3	21.4	(2.4)	15.9	(2.7)	12.8	(2.1)
Total	100.0		100.0		100.0	

The use of cow trainers was associated with cleaner cows. A higher percentage of cows on operations with trainers had a hygiene score of 1 (50.3 percent) compared with cows on operations without trainers (37.6 percent).

Almost twice the percentage of cows had a hygiene score of 3 on operations that did not use cow trainers compared with cows on operations that did use cow trainers (23.6 and 14.1 percent, respectively).

s. Percentage of cows by hygiene score and by use of cow trainers

	Percent Cows			
	Cow Trainers			
	Yes		No	
Hygiene Score	Percent	Std. Error	Percent	Std. Error
1	50.3	(3.1)	37.6	(5.0)
2	35.6	(1.9)	38.8	(3.6)
3	14.1	(1.5)	23.6	(2.8)
Total	100.0		100.0	

Trainer location was not associated with hygiene scores. The distance from the trainer to the gutter or from the trainer to the stall bed was not associated with cleanliness.

t. For tie-stall and stanchion operations, percentage of cows by hygiene score and by average distance from trainer to gutter

	Percent Cows							
	Average Distance (Inches)							
	Less than 46.0		46.0–49.9		50.0–53.9		54.0 or More	
Hygiene Score	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
1	52.6	(6.1)	55.0	(5.9)	47.9	(5.0)	42.5	(6.3)
2	32.1	(3.6)	33.8	(3.7)	38.4	(2.4)	39.4	(4.1)
3	15.3	(3.6)	11.2	(2.7)	13.7	(3.3)	18.1	(2.7)
Total	100.0		100.0		100.0		100.0	

u. For tie-stall and stanchion operations, percentage of cows by hygiene score and by average distance from trainer to bed

	Percent Cows					
	Average Distance (Inches)					
	Less than 58.0		58.0–59.9		60.0 or More	
Hygiene Score	Percent	Std. Error	Percent	Std. Error	Percent	Std. Error
1	54.0	(6.5)	45.5	(5.1)	51.3	(4.8)
2	33.8	(4.2)	39.6	(3.5)	33.9	(2.4)
3	12.2	(2.7)	14.9	(2.4)	14.8	(2.9)
Total	100.0		100.0		100.0	

No differences were observed in spring and summer in the percentage of cows by hygiene score.

v. Percentage of cows by hygiene score and by season

	Percent Cows			
	Season			
	Spring		Summer	
Hygiene Score	Percent	Std. Error	Percent	Std. Error
1	46.9	(2.2)	46.0	(2.5)
2	39.0	(1.7)	40.2	(1.9)
3	14.1	(1.1)	13.8	(1.4)
Total	100.0		100.0	

3. Hock results

Note: Differences in this section were analyzed using STATA and SUDAAN software. P values less than 0.05 were considered statistically significant (see Section III: Methodology, p 156).

Hock scoring was performed on 477 operations; freestall operations accounted for 282 of these operations, providing the majority of all cows scored (67.9 percent). Approximately twice as many cows were scored on freestall, dry lot, and other multiple-animal area operations than on tie-stall or stanchion operations. These differences in animals scored among different housing types are directly related to herd size.

a. Number of operations assessed and number of cows assigned hock scores, by housing type

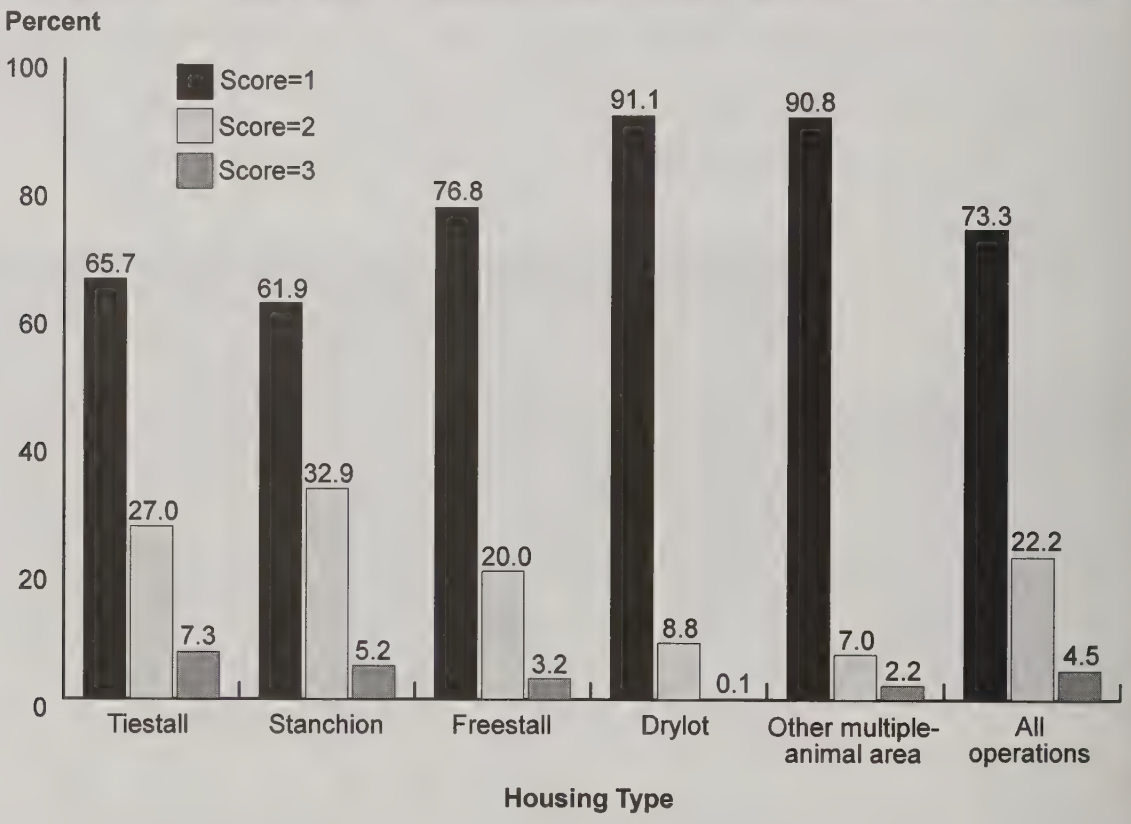
	Number Scored					
	Housing Type					
Parameter	Tie stall	Stanchion	Freestall	Dry lot	Other Multiple-animal Area	All Operations
Total number of operations assessed	102	27	282	30	38	477
Total number of cows scored	5,558	1,266	26,264	2,547	3,064	38,699
Average number of cows scored per operation	54.5	46.9	93.1	84.9	80.6	81.1

Operations with dry lots and other multiple-animal areas had the highest percentage of cows assigned a hock score of 1 (91.1 and 90.8 percent of cows, respectively). Approximately three of four cows on freestall operations (76.8 percent) were assigned a hock score of 1, while tie-stall and stanchion operations had the lowest percentage of cows with a score of 1 (65.7 and 61.9 percent, respectively). Dry-lot operations had a lower percentage of cows with hock scores of 3 compared with tie-stall, stanchion, and freestall operations.

b. Percentage of cows by hock score and by housing type

	Percent Cows											
	Housing Type											
	Tie stall		Stanchion		Freestall		Dry lot		Other Multiple-animal Area		All Operations	
Hock Score	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
1	65.7	(2.6)	61.9	(5.2)	76.8	(1.9)	91.1	(3.4)	90.8	(3.1)	73.3	(1.4)
2	27.0	(2.2)	32.9	(5.5)	20.0	(1.7)	8.8	(3.4)	7.0	(2.0)	22.2	(1.2)
3	7.3	(1.0)	5.2	(1.1)	3.2	(0.4)	0.1	(0.1)	2.2	(1.4)	4.5	(0.4)
Total	100.0		100.0		100.0		100.0		100.0		100.0	

Percentage of Cows by Hock Score and by Housing Type



Almost 9 of 10 cows (89.5 percent) on operations that used dirt as a stall base were assigned a hock score of 1. The lowest percentage of cows assigned a hock score of 1 were on operations that used concrete, rubber mats, or mattresses as a stall base (72.8, 65.9, and 60.6 percent, respectively). The lowest percentage of cows assigned a hock score of 3 (0.7 percent) were on operations that used dirt as a stall base, while the highest percentage of cows with a score of 3 were on operations that used concrete, rubber mats, or mattresses as a stall base (5.6, 7.2, and 5.0 percent, respectively).

c. Percentage of cows by hock score and by type of stall base

	Percent Cows									
	Type of Stall Base									
	Concrete		Dirt		Rubber Mat		Mattress		Other*	
Hock Score	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
1	72.8	(2.8)	89.5	(2.0)	65.9	(3.0)	60.6	(3.3)	82.5	(2.6)
2	21.6	(2.5)	9.8	(1.9)	26.9	(2.3)	34.4	(3.2)	14.9	(2.2)
3	5.6	(0.9)	0.7	(0.2)	7.2	(1.0)	5.0	(0.9)	2.6	(0.7)
Total	100.0		100.0		100.0		100.0		100.0	

*Includes waterbeds.

A higher percentage of cows bedded with fine or coarse sand, composted or dried manure, or no bedding (used primarily by operations with freestalls, dry lots, or other multiple-animal areas) had hock scores of 1 compared with cows bedded with straw or sawdust (used primarily by tie-stall and stanchion operations). Similarly, a lower percentage of cows bedded in coarse sand and composted manure had hock scores of 3 compared with cows on straw, sawdust, or other bedding.

d. Percentage of cows by hock score and by type of bedding

	Percent Cows													
	Type of Bedding Type													
	Straw		Sawdust		Fine Sand		Coarse Sand		Composted Manure		Dried Manure		Other*		None	
Hock Score	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
1	68.1	(2.6)	63.5	(2.5)	83.6	(4.1)	90.7	(2.4)	86.7	(5.8)	86.7	(5.0)	71.6	(4.3)	80.5	(4.8)
2	25.3	(2.3)	31.4	(2.4)	13.7	(3.3)	8.7	(2.3)	13.2	(5.8)	10.8	(4.1)	23.7	(4.1)	16.1	(3.8)
3	6.6	(1.0)	5.1	(0.8)	2.7	(1.0)	0.6	(0.2)	0.1	(0.1)	2.5	(1.5)	4.7	(0.9)	3.4	(1.5)
Total	100.0		100.0		100.0		100.0		100.0		100.0		100.0		100.0	

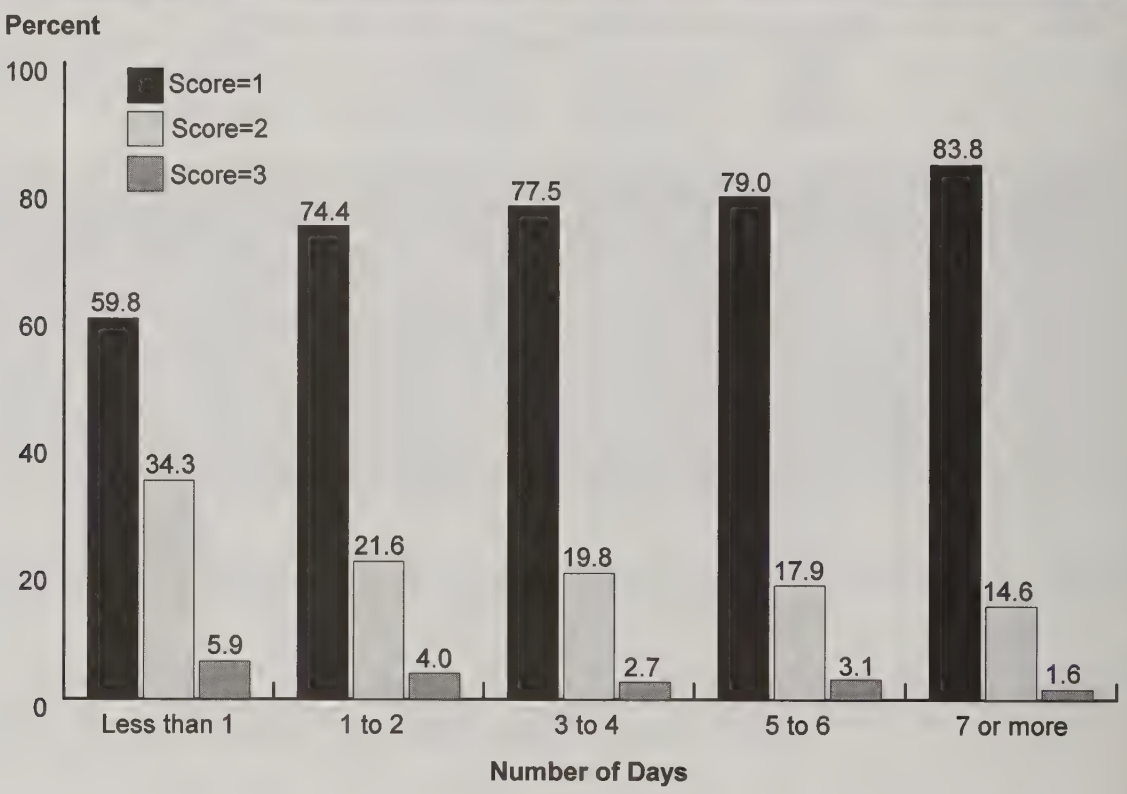
*Includes shredded newspaper.

As the number of days since bedding was added increased, the percentage of cows assigned a hock score of 1 increased. Housing type, bedding type, and bedding quantity likely influenced this relationship. The frequency and type of bedding and bedding quantity/stall condition were associated with housing type. Since operations with freestall or other multiple-animal areas typically had more days since bedding was added/changed, these results are in agreement with hock scores presented by housing type.

e. Percentage of cows by hock score and by number of days since bedding was added/changed

	Percent Cows									
	Number of Days									
	Less than 1		1 to 2		3 to 4		5 to 6		7 or More	
Hock Score	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
1	59.8	(6.9)	74.4	(3.2)	77.5	(4.4)	79.0	(4.5)	83.8	(2.4)
2	34.3	(5.8)	21.6	(2.7)	19.8	(3.8)	17.9	(3.7)	14.6	(2.1)
3	5.9	(1.8)	4.0	(0.9)	2.7	(0.8)	3.1	(0.9)	1.6	(0.6)
Total	100.0		100.0		100.0		100.0		100.0	

Percentage of Cows by Hock Score and by Number of Days Since Bedding was Added/Changed



The percentage of cows by hock scores was associated with bedding quantity. As bedding quantity decreased until the stall base was mostly exposed, a lower percentage of cows had hock scores of 1. In addition, a higher percentage of cows had hock scores of 1 when no bedding was present than when the stall base was exposed. Operations that did not use bedding were typically dry lot facilities on which cows lie on dirt.

f. Percentage of cows by hock score and by bedding quantity/stall condition in majority of stalls

	Percent Cows									
	Bedding Quantity/Stall Condition									
	Base not Exposed, Bedding Level with Curb		Base not Exposed, Bedding Slightly Dished Out		Base Exposed (Less than 50 Percent)		Base Mostly Exposed (More than 50 Percent)		No Bedding Present*	
Hock Score	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
1	85.3	(2.8)	79.5	(2.4)	65.3	(2.6)	61.9	(3.5)	81.9	(4.2)
2	13.1	(2.5)	16.8	(1.9)	28.6	(2.4)	32.0	(3.2)	14.9	(3.3)
3	1.6	(0.6)	3.7	(0.8)	6.1	(0.8)	6.1	(1.1)	3.2	(1.3)
Total	100.0		100.0		100.0		100.0		100.0	

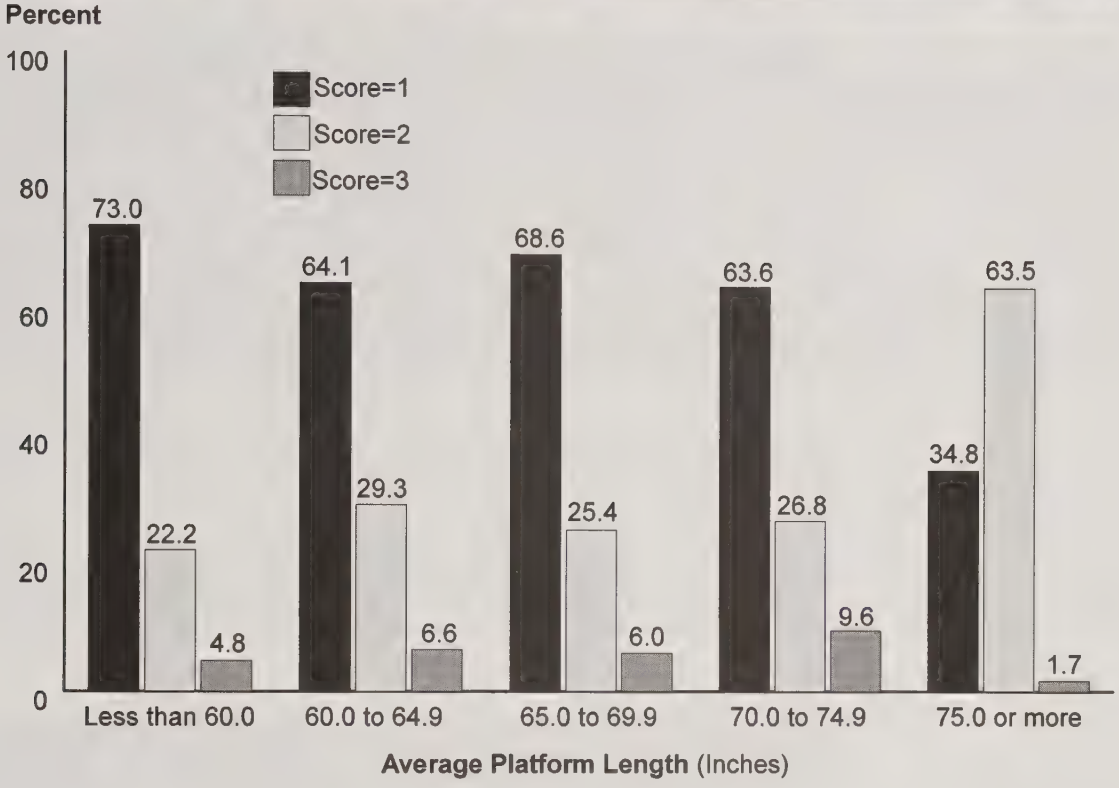
*80.9 percent of operations on which no bedding was present were dry lot operations or operations with other multiple-animal areas.

Platform lengths of 75.0 inches or more were associated with the lowest percentage of cows assigned a hock score of 1 (34.8 percent).

g. For tie-stall and stanchion operations, percentage of cows by hock score and by average platform length

	Percent Cows									
	Average Platform Length (Inches)									
	Less than 60.0		60.0–64.9		65.0–69.9		70.0–74.9		75.0 or More	
Hock Score	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
1	73.0	(6.9)	64.1	(5.4)	68.6	(3.1)	63.6	(4.3)	34.8	(8.3)
2	22.2	(5.5)	29.3	(5.7)	25.4	(2.5)	26.8	(3.1)	63.5	(8.4)
3	4.8	(2.2)	6.6	(1.7)	6.0	(1.1)	9.6	(2.0)	1.7	(0.9)
Total	100.0		100.0		100.0		100.0		100.0	

For Tie-stall and Stanchion Operations, Percentage of Cows by Hock Score and by Average Platform Length



Stall length on freestall operations was not associated with specific hock scores.

h. For freestall operations, percentage of cows by hock score and by average stall length

	Percent Cows									
	Average Stall Length (Inches)									
	Less than 82.0		82.0–85.9		86.0–91.9		92.0–95.9		96.0 or More	
Hock Score	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
1	81.0	(7.2)	72.3	(4.1)	78.7	(2.8)	79.9	(4.5)	64.3	(7.6)
2	15.7	(6.2)	24.1	(3.7)	18.0	(2.3)	17.7	(4.2)	32.0	(7.6)
3	3.3	(1.3)	3.6	(0.9)	3.3	(0.8)	2.4	(0.7)	3.7	(1.2)
Total	100.0		100.0		100.0		100.0		100.0	

Stall width was not associated with hock scores.

i. Percentage of cows by hock score and by average stall width

	Percent Cows									
	Average Stall Width (Inches)									
	Less than 42.0		42.0–43.9		44.0–45.9		46.0–47.9		48.0–49.9		50.0 or More	
Hock Score	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
1	73.5	(4.9)	75.5	(5.4)	77.5	(3.4)	74.9	(2.9)	64.5	(4.4)	65.6	(6.8)
2	22.4	(4.4)	21.4	(5.1)	18.7	(2.7)	21.0	(2.4)	27.7	(4.3)	27.0	(5.5)
3	4.1	(1.4)	3.1	(0.9)	3.8	(0.9)	4.1	(0.8)	7.8	(1.6)	7.4	(2.5)
Total	100.0		100.0		100.0		100.0		100.0		100.0	

Operations with stationary neck rails had a lower percentage of cows with hock scores of 1 (75.8 percent) compared with operations that had moveable neck rails or no neck rails (87.1 and 93.4 percent, respectively).

j. For freestall operations, percentage of cows by hock score and by type of neck rail

	Percent Cows					
	Type of Neck Rail					
	Stationary		Moveable		None	
Hock Score	Percent	Std. Error	Percent	Std. Error	Percent	Std. Error
1	75.8	(2.0)	87.1	(3.9)	93.4	(3.5)
2	20.7	(1.8)	12.0	(3.7)	6.6	(3.5)
3	3.5	(0.4)	0.9	(0.6)	0.0	(--)
Total	100.0		100.0		100.0	

Although there appeared to be a trend toward more hock lesions as the distance from neck rail to curb increased, no significant differences were found.

k. For freestall operations, percentage of cows by hock score and by average distance from neck rail to curb

	Percent Cows							
	Average Distance (Inches)							
	Less than 60.0		60.0–65.9		66.0–71.9		72.0 or More	
Hock Score	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
1	81.1	(4.3)	79.0	(2.5)	74.8	(3.8)	68.7	(6.2)
2	16.1	(3.6)	18.2	(2.4)	21.7	(3.1)	27.3	(5.5)
3	2.8	(0.9)	2.8	(0.5)	3.5	(0.8)	4.0	(0.9)
Total	100.0		100.0		100.0		100.0	

Neck rail height was not associated with hock scores.

l. For freestall operations, percentage of cows by hock score and by average distance from neck rail to bedding surface

Percent Cows

Average Distance (Inches)

	Less than 40.0		40.0–45.9		46.0–49.9		50.0 or More	
Hock Score	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
1	80.8	(4.1)	74.6	(2.9)	77.7	(3.2)	83.4	(5.2)
2	16.7	(3.6)	22.0	(2.6)	18.9	(2.7)	14.4	(4.2)
3	2.5	(0.6)	3.4	(0.6)	3.4	(0.9)	2.2	(1.1)
Total	100.0		100.0		100.0		100.0	

Operations that used PVC or other plastic pipe for brisket locators had a lower percentage of cows with hock scores of 1 and a higher percentage of cows with hock scores of 3 compared with operations that used locators made of wood, other materials, or did not have brisket locators.

m. For freestall operations, percentage of cows by hock score and by type of brisket locator

Percent Cows

Type of Brisket Locator

	Concrete		Wood		PVC or Other Plastic Pipe		Other		None	
Hock Score	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
1	78.0	(10.4)	74.3	(3.3)	63.2	(4.6)	80.4	(3.7)	83.4	(2.9)
2	16.1	(6.9)	22.6	(3.2)	30.9	(4.1)	16.7	(3.4)	14.6	(2.5)
3	5.9	(3.8)	3.1	(0.6)	5.9	(1.1)	2.9	(0.7)	2.0	(0.5)
Total	100.0		100.0		100.0		100.0		100.0	

The distance from the curb to brisket locator was not associated with hock scores.

n. For freestall operations, percentage of cows by hock score and by average distance form curb to brisket locator

	Percent Cows									
	Average Distance (Inches)									
	Less than 66.0		66.0–67.9		68.0–69.9		70.0–71.9		72.0 or More	
Hock Score	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
1	79.9	(3.0)	74.2	(6.2)	71.6	(6.5)	63.1	(5.2)	71.7	(5.2)
2	17.2	(2.8)	22.6	(6.1)	23.4	(5.1)	32.1	(4.8)	24.0	(4.3)
3	2.9	(0.6)	3.2	(0.8)	5.0	(2.1)	4.8	(1.0)	4.3	(1.3)
Total	100.0		100.0		100.0		100.0		100.0	

The type of lunge barrier material was not associated with hock scores.

o. For freestall operations, percentage of cows by hock score and by lunge barrier material

	Percent Cows									
	Lunge Barrier Material									
	Concrete		Wood		Cable		Other		None	
Hock Score	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
1	68.7	(7.2)	78.4	(2.8)	69.5	(10.4)	77.0	(3.8)	80.3	(3.0)
2	25.9	(5.7)	18.6	(2.5)	25.5	(8.6)	20.5	(3.7)	16.8	(2.5)
3	5.4	(1.8)	3.0	(0.7)	5.0	(1.8)	2.5	(0.6)	2.9	(0.7)
Total	100.0		100.0		100.0		100.0		100.0	

Curb height was not associated with hock scores.

p. For freestall operations, percentage of cows by hock score and by curb height

	Percent Cows					
	Curb Height (Inches)					
	Less than 8.0		8.0–12.9		13.0 or More	
Hock Score	Percent	Std. Error	Percent	Std. Error	Percent	Std. Error
1	84.1	(3.4)	77.9	(2.0)	77.8	(5.5)
2	14.2	(3.0)	18.8	(1.7)	19.8	(4.8)
3	1.7	(0.6)	3.3	(0.5)	2.4	(1.2)
Total	100.0		100.0		100.0	

Curb widths of less than 6.0 inches were associated with a lower percentage of cows assigned a hock score of 1 (70.4 percent), while widths of 9.0 inches or more were associated with the lowest percentage of cows assigned a score of 3 (0.7 percent).

q. For freestall operations, percentage of cows by hock score and by curb width

	Percent Cows					
	Curb Width (Inches)					
	Less than 6.0		6.0–8.9		9.0 or More	
Hock Score	Percent	Std. Error	Percent	Std. Error	Percent	Std. Error
1	70.4	(5.1)	84.7	(2.5)	86.3	(5.6)
2	25.3	(4.2)	13.0	(2.1)	13.0	(5.4)
3	4.3	(1.3)	2.3	(0.6)	0.7	(0.4)
Total	100.0		100.0		100.0	

The percentage of stalls with gutter grates was not associated with hock scores.

r. For tie-stall and stanchion operations, percentage of cows by hock score and by percentage of stalls with gutter grates

	Percent Cows					
	Percent Stalls with Gutter Grates					
	0.0		0.1–49.9		50.0 or More	
Hock Score	Percent	Std. Error	Percent	Std. Error	Percent	Std. Error
1	61.9	(3.9)	72.0	(3.8)	63.6	(4.1)
2	30.9	(3.8)	21.2	(2.6)	30.0	(3.6)
3	7.2	(1.4)	6.8	(1.6)	6.4	(1.2)
Total	100.0		100.0		100.0	

The presence of cow trainers was not associated with hock scores.

s. For tie-stall and stanchion operations, percentage of cows by hock score and by use of cow trainers

	Percent Cows			
	Cow Trainers			
	Yes		No	
Hock Score	Percent	Std. Error	Percent	Std. Error
1	63.3	(2.8)	66.6	(4.3)
2	29.1	(2.4)	27.8	(4.3)
3	7.6	(1.1)	5.6	(1.2)
Total	100.0		100.0	

The distance from the trainer to the gutter was not associated with hock scores.

t. For tie-stall and stanchion operations, percentage of cows by hock score and by average distance from trainer to gutter

	Percent Cows							
	Average Distance (Inches)							
	Less than 46.0		46.0–49.9		50.0–53.9		54.0 or More	
Hock Score	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
1	66.9	(6.4)	67.6	(3.7)	58.2	(5.8)	57.3	(6.8)
2	25.2	(4.6)	27.1	(3.1)	32.8	(4.6)	32.6	(7.2)
3	7.9	(2.6)	5.3	(1.3)	9.0	(2.9)	10.1	(2.3)
Total	100.0		100.0		100.0		100.0	

The distance from the trainer to the stall bed was not associated with hock scores.

u. For tie-stall and stanchion operations, percentage of cows by hock score and by average distance from trainer to bed

	Percent Cows					
	Average Distance (Inches)					
	Less than 58.0		58.0–59.9		60.0 or More	
Hock Score	Percent	Std. Error	Percent	Std. Error	Percent	Std. Error
1	66.6	(5.7)	60.9	(5.2)	64.6	(3.5)
2	28.6	(5.6)	29.8	(4.0)	27.4	(2.9)
3	4.8	(1.5)	9.3	(2.4)	8.0	(1.5)
Total	100.0		100.0		100.0	

The season in which assessments were made did not impact hock scores.

v. Percentage of cows by hock score and by season

	Percent Cows			
	Season			
	Spring		Summer	
Hock Score	Percent	Std. Error	Percent	Std. Error
1	71.2	(1.9)	76.0	(2.0)
2	24.6	(1.8)	19.2	(1.5)
3	4.2	(0.5)	4.8	(0.7)
Total	100.0		100.0	

D. Comfort Assessments

Note: Data for all estimates in Section II were obtained from operations with 30 or more cows that completed the cow comfort assessment. Housing types in this section refer to the buildings or areas that housed the majority of fresh (recently calved) cows. For most operations, these housing areas also housed the majority of lactating cows.

Note: Differences in this section were analyzed using STATA and SUDAAN software. P values less than 0.05 were considered statistically significant (see Section III: Methodology, p 156).

Four comfort parameters were assessed: perching (standing with the front feet inside the stall), standing (with all feet inside the stall), lying, and the cow comfort index (the proportion of cows in contact with a stall that are lying down). Assessments were completed at a single point in time and conducted no earlier than 2 hours after milking and no later than 2 hours prior to the next milking which removed the impact of major cattle movements from the assessments.

1. Cows assessed

Comfort parameters were evaluated on 485 operations, and the pens and areas evaluated housed 52,490 cows. The majority of operations (290) and cows (39,014) assessed were on freestall operations.

a. Number of operations and cows assessed for comfort, by housing type

	Housing Type					
Parameter	Tie Stall	Stanchion	Freestall	Dry lot	Other Multiple-animal Area	All Operations
Total number of operations assessed	101	27	290	30	37	485
Total number of cows assessed	5,783	1,234	39,014	2,828	3,631	52,490
Average number of cows assessed per operation/pen	57.3	45.7	134.5	94.3	98.1	108.2

For the majority of operations (72.2 percent) the pen being assessed housed cows of all lactation stages.

b. Percentage of operations by type of cow being assessed and by housing type

	Percent Operations							
	Housing Type							
	Freestall		Dry lot		Other Multiple-animal Area		All Operations	
Cows Assessed	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Early lactation (1 to 90 days in milk)	12.6	(2.3)	23.5	(8.4)	9.8	(4.6)	13.4	(2.0)
Midlactation (91 to 180 days in milk)	7.3	(1.7)	4.6	(3.0)	13.3	(5.3)	7.7	(1.5)
Late lactation (more than 180 days in milk)	4.5	(1.6)	0.9	(0.9)	5.1	(3.5)	4.1	(1.4)
All lactation stages	72.4	(3.1)	71.0	(9.5)	71.6	(7.5)	72.2	(2.7)
Other	3.2	(1.2)	0.0	(--)	0.2	(0.2)	2.6	(0.9)
Total	100.0		100.0		100.0		100.0	

About 4 of 10 freestall operations (42.6 percent) and all operations (40.4 percent) were at 95.0 percent or more of the maximum number of cows ever housed in the pen or area.

Approximately 50 to 60 percent of operations with dry lot and other multiple-animal areas were at less than 85 percent of the maximum number of cows ever housed in the pen or area.

c. Percentage of operations by percentage of maximum number of cows ever housed in the pen or area, and by housing type

	Percent Operations							
	Housing Type							
	Freestall		Dry lot		Other Multiple-animal Area		All Operations	
Percent Maximum Number of Cows	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Less than 85.0	27.6	(3.9)	59.0	(13.6)	48.8	(9.8)	32.9	(3.6)
85.0 to 94.9	29.8	(3.7)	10.2	(4.6)	18.6	(8.3)	26.7	(3.1)
95.0 or more	42.6	(4.0)	30.8	(13.4)	32.6	(8.8)	40.4	(3.5)
Total	100.0		100.0		100.0		100.0	

2. Season and temperature

Increases in temperature (i.e., heat stress) have been associated with decreases in duration of lying in dairy cows (Zähner et al., 2004). The implementation of heat abatement methods, such as shade, fans, and misters, can decrease heat stress in cattle, which can occur in any region of the United States during summer.

Although assessments of most housing types were split about equally between spring and summer, the majority of stanchion operations (74.7 percent) were assessed during spring.

a. Percentage of operations by season of assessment and by housing type

Percent Operations

	Housing Type											
	Tie stall		Stanchion		Freestall		Dry lot		Other Multiple-animal Area		All Operations	
Season	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Spring	51.7	(5.5)	74.7	(8.1)	54.4	(4.0)	42.6	(12.7)	39.0	(9.2)	54.6	(2.9)
Summer	48.3	(5.5)	25.3	(8.1)	45.6	(4.0)	57.4	(12.7)	61.0	(9.2)	45.4	(2.9)
Total	100.0		100.0		100.0		100.0		100.0		100.0	

The operation average temperature at the time of assessment was higher for dry lot operations than stanchion operations, possibly because the the two types of operations might have been assessed in different seasons.

b. Operation average temperature at time of assessment, by housing type

Operation Average Temperature (°F)

	Housing Type											
	Tie stall		Stanchion		Freestall		Dry lot		Other Multiple-animal Area		All Operations	
	Avg.	Std. Error	Avg.	Std. Error	Avg.	Std. Error	Avg.	Std. Error	Avg.	Std. Error	Avg.	Std. Error
	65.3	(1.3)	60.6	(2.8)	65.1	(1.2)	70.5	(2.9)	64.9	(2.4)	64.8	(0.8)

The majority of all operations were assessed when the temperature was between 60 and 80 degrees; however, the majority of stanchion operations were assessed between 50 and 70 degrees, and more than 4 of 10 dry lot operations (44.0 percent) were assessed when the temperature was 80 degrees or higher.

c. Percentage of operations by temperature at the time of assessment and by housing type

	Percent Operations											
	Housing Type											
	Tie stall		Stanchion		Freestall		Dry lot		Other Multiple-animal Area		All Operations	
Temperature (°F)	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Less than 50	11.1	(3.8)	17.4	(8.5)	16.6	(3.3)	11.0	(5.3)	11.8	(5.1)	14.0	(2.2)
50 to 59	15.6	(3.8)	23.4	(8.6)	10.2	(2.1)	9.7	(5.8)	18.7	(8.1)	14.6	(2.1)
60 to 69	25.6	(5.0)	29.3	(10.1)	25.4	(3.7)	16.3	(7.3)	19.9	(8.4)	25.4	(2.8)
70 to 79	39.9	(5.4)	13.2	(5.9)	28.0	(3.7)	19.0	(9.0)	31.9	(9.1)	30.6	(2.8)
80 or above	7.8	(2.8)	16.7	(7.1)	19.8	(3.3)	44.0	(14.2)	17.7	(6.1)	15.4	(2.1)
Total	100.0		100.0		100.0		100.0		100.0		100.0	

3. Timing

Since movement of cows around the time of milking can impact cow comfort assessments (Cook et al., 2005), assessors were advised to perform assessments no earlier than 2 hours after milking and no later than 2 hours prior to the next milking.

The operation average time since the last milking was more than 2 hours for all housing types. The operation average time until the next milking was well above 2 hours for all housing types, ranging from 5.1 hours for freestall operations to 6.2 hours for multiple-animal area and tie-stall operations. The time until next feeding ranged from 4.0 hours on stanchion operations to 8.3 hours on freestall operations.

a. Operation average time of assessment in relation to feeding and milking, by housing type

Operation Average Time (Hours)

	Housing Type											
	Tie stall		Stanchion		Freestall		Dry lot		Other Multiple-animal Area		All Operations	
Hours...	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Since last milking	5.0	(0.3)	5.6	(0.7)	5.1	(0.2)	4.9	(0.6)	4.6	(0.6)	5.1	(0.2)
Until next milking	6.2	(0.3)	5.6	(0.6)	5.1	(0.2)	5.8	(0.5)	6.2	(0.6)	5.7	(0.2)
Since last feeding	4.2	(0.4)	3.2	(0.6)	4.3	(0.3)	5.1	(1.8)	6.8	(1.6)	4.3	(0.2)
Until next feeding	5.2	(0.6)	4.0	(0.7)	8.3	(0.6)	7.3	(0.7)	7.3	(1.1)	6.4	(0.3)

Approximately 90 percent of operations were assessed 2.0 hours or more after the last milking.

b. Percentage of operations by number of hours *since last milking* that assessment was conducted and by housing type

	Percent Operations											
	Housing Type											
	Tie stall		Stanchion		Freestall		Dry lot		Other Multiple-animal Area		All Operations	
Number of Hours	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Fewer than 2.0	11.6	(3.7)	10.6	(7.8)	5.3	(1.5)	1.5	(1.6)	2.2	(2.2)	8.2	(1.9)
2.0 to 3.9	21.9	(4.9)	19.5	(7.8)	29.7	(4.1)	47.2	(14.4)	38.5	(9.3)	26.6	(2.8)
4.0 to 5.9	29.5	(5.1)	27.1	(8.4)	29.9	(3.8)	25.5	(11.8)	35.6	(9.0)	29.4	(2.8)
6.0 or more	37.0	(5.4)	42.8	(10.7)	35.1	(3.9)	25.8	(9.0)	23.7	(8.7)	35.8	(3.0)
Total	100.0		100.0		100.0		100.0		100.0		100.0	

Only 6.0 percent of all operations were assessed fewer than 2.0 hours before the next milking.

c. Percentage of operations by number of hours *until next milking* that assessment was conducted and by housing type

Percent Operations

	Housing Type									
	Tie stall		Stanchion		Freestall		Dry lot		Other Multiple-animal Area		All Operations	
Number of Hours	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Fewer than 2.0	4.4	(2.0)	6.8	(4.7)	7.0	(1.6)	7.2	(4.5)	8.5	(7.9)	6.0	(1.2)
2.0 to 3.9	16.9	(4.3)	13.5	(8.1)	21.0	(3.2)	16.1	(6.5)	9.2	(6.1)	17.6	(2.3)
4.0 to 5.9	17.6	(3.9)	37.3	(10.4)	32.9	(3.8)	14.4	(7.9)	26.6	(8.1)	26.2	(2.6)
6.0 or more	61.1	(5.4)	42.4	(10.6)	39.1	(4.3)	62.3	(11.8)	55.7	(10.1)	50.2	(3.1)
Total	100.0		100.0		100.0		100.0		100.0		100.0	

The delivery of feed also influences cow movement and can impact cow assessments. Although there were guidelines for doing the assessment relative to milking, no restrictions were placed relative to feeding.

Approximately 25 percent of assessments were conducted in each of the time periods listed in the following table.

d. Percentage of operations by number of hours *since last feeding* that assessment was conducted and by housing type

Percent Operations

	Housing Type											
	Tie stall		Stanchion		Freestall		Dry lot		Other Multiple-animal Area		All Operations	
Number of Hours	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Fewer than 2.0	24.3	(4.6)	37.0	(9.8)	21.7	(3.9)	22.9	(11.0)	15.5	(6.7)	24.5	(2.9)
2.0 to 3.9	27.0	(5.1)	27.2	(8.9)	27.6	(4.0)	30.2	(13.0)	34.9	(9.0)	27.8	(2.8)
4.0 to 5.9	27.7	(5.2)	25.8	(8.7)	29.3	(3.6)	18.7	(8.6)	17.8	(7.2)	27.1	(2.8)
6.0 or more	21.0	(4.7)	10.0	(5.6)	21.4	(3.0)	28.2	(14.5)	31.8	(10.7)	20.6	(2.6)
Total	100.0		100.0		100.0		100.0		100.0		100.0	

More than 4 of 10 operations (44.0 percent) were assessed 6.0 or more hours until the next feeding.

e. Percentage of operations by number of hours *until next feeding* that assessment was conducted and by housing type

Percent Operations

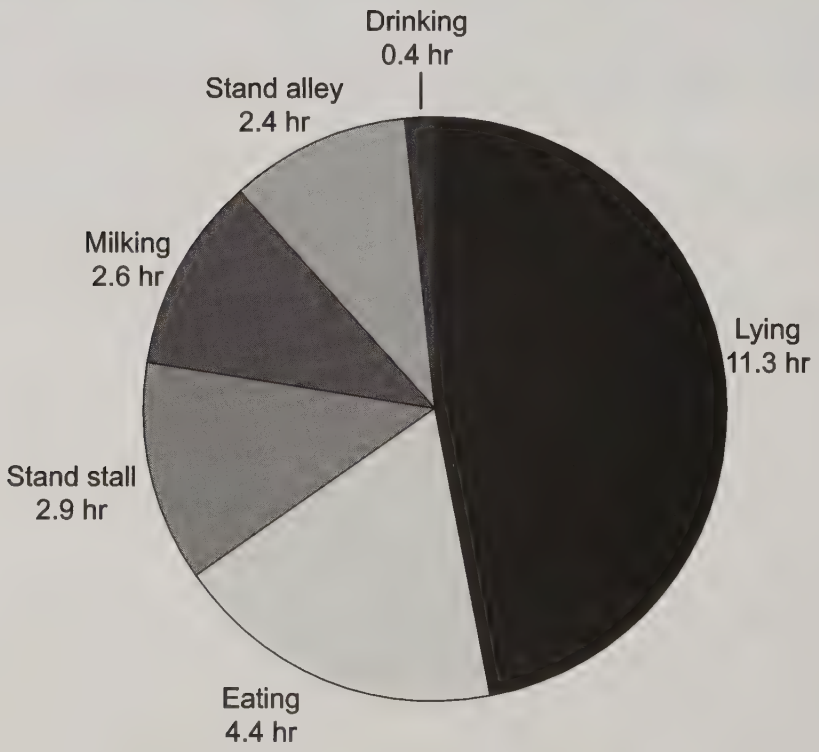
	Housing Type					
	Tie stall	Stanchion	Freestall	Dry lot	Other Multiple-animal Area	All Operations
Number of Hours	Pct. Std. Error	Pct. Std. Error	Pct. Std. Error	Pct. Std. Error	Pct. Std. Error	Pct. Std. Error
Fewer than 2.0	25.7 (5.1)	30.7 (10.2)	15.7 (3.4)	5.4 (3.5)	20.9 (10.6)	21.4 (2.8)
2.0 to 3.9	22.0 (4.5)	16.2 (7.1)	12.5 (2.3)	6.2 (2.9)	0.4 (0.3)	15.9 (2.2)
4.0 to 5.9	14.1 (4.0)	33.0 (10.5)	18.7 (3.1)	13.5 (6.4)	22.3 (8.0)	18.7 (2.5)
6.0 or more	38.2 (5.5)	20.1 (9.1)	53.1 (4.2)	74.9 (8.7)	56.4 (10.4)	44.0 (3.2)
Total	100.0	100.0	100.0	100.0	100.0	100.0

4. Comfort parameters—perching, standing, lying, and cow comfort index

Note: All estimates in this section were derived from operations with freestalls, which included some operations that reported having freestalls in other multiple-animal areas.

Cows have multiple activities during the day including eating, milking, socializing, and lying. A video of 208 cows in 17 freestall operations was analyzed to determine time budgets for cows. The single largest amount of time was spent lying in a stall (11.3 hours; range 2.8 to 17.6 hours). On average, cows ate for an average of 4.4 hours per day (range 1.4 to 8.1 hours). Cows spent an average of almost 3 hours a day standing in a stall (range 0.3 to 13.0 hours) [Cook, 2010].

Dairy Cow Time Budget



Multiple measures have been evaluated to determine how well facilities are designed based on cow use. The goal of research regarding these measures is to be able to make an assessment at a single point in time that reflects activity throughout the day. In this report, the following four measures are considered:

1. Percentage of cows in the pen that are perching.
2. Percentage of cows standing with all four feet in the stall.
3. Percentage of cows lying in the stall.
4. Cow comfort index (CCI).

Perching is the term used to describe cows standing with both front feet in a stall. Perching occurs when cows enter and exit a stall, but prolonged perching suggests problems with management. Associations found in the analysis of these data showed that increased perching was associated with decreased bedding quantity, increased temperature, shorter stall lengths, decreased time since feeding, and more cows per stall (Lombard et al., 2010). Although the distance of the neck rail to the rear curb has been associated with perching (Tucker et al., 2005; Bernardi et al., 2009; Fregonesi et al., 2009), no such association was found in this study.

The CCI is the number of cows lying in a stall divided by the number of cows in contact (i.e., perching, standing, or lying) with a stall. Overton et al. (2003) suggested that a target CCI should be around 85 percent of cows lying in a stall when measured 1 hour after milking, which coincides with peak lying activity.

Increased perching has been associated with shorter stalls (Tucker et al., 2004; Lombard et al., 2010), narrow stalls (Tucker et al., 2004), more restrictive neck rail placement (Tucker et al., 2005; Fregonesi et al., 2009), decreased stocking density (Hill et al., 2009), and higher ambient temperatures (Overton et al., 2002; Zähner et al., 2004). Shorter distances from the rear curb to the neck rail are associated with increased perching, while longer distances may lead to more standing fully in the stall (Tucker et al., 2005; Fregonesi et al., 2009; Lombard et al., 2010). When the neck rail is removed and cows are allowed to stand fully in the stall, gait scores are improved (Bernardi et al., 2009). Increased standing in stalls has been associated with stall base and bedding types, with cows spending more time standing on rubber mats or mattresses (Tucker et al., 2003; Cook et al., 2004). Increased lying behavior has been associated with sand bedding compared with organic bedding types and during cooler months (Lombard et al., 2010), although cows without prior experience lying on sand spend less time lying (Manninen et al., 2002; Tucker et al., 2003; Norring et al., 2010)..

The CCI has been the most popular index used to evaluate the comfort of dairy cows. However, no studies have found an association between CCI and lying times. The reciprocal of CCI (1-CCI), or stall standing index, was significantly associated with stall standing times when conducted 2 hours prior to milking and may be an indicator of increased lameness (Cook et al., 2005).

A higher percentage of cows were observed perching and standing with all four feet in stalls on freestall operations (8.5 and 10.0 percent, respectively) than on operations using other multiple-animal areas (3.7 and 0.8 percent, respectively). Although on operations with other multiple-animal areas the percentage of cows lying was much lower than in freestall operations (8.1 and 39.6 percent, respectively), the CCI was not different. This finding suggests that the numbers of cows lying in stalls as a percentage of those touching a stall were not different in the two housing types. Cows in other multiple-animal area housing had additional bedding choices.

a. Percentage of cows by comfort parameter and by housing type

	Percent Cows					
	Housing Type					
	Freestall		Other Multiple-animal Area		All Operations	
Parameter	Percent	Standard Error	Percent	Standard Error	Percent	Standard Error
Perching	8.5	(0.7)	3.7	(1.3)	8.3	(0.7)
Standing	10.0	(1.1)	0.8	(0.8)	9.6	(1.1)
Lying	39.6	(1.7)	8.1	(3.5)	38.3	(1.7)
CCI	68.2	(2.0)	64.2	(9.8)	68.1	(2.0)

Stall-base type did not have a significant impact on any comfort parameter.

b. Percentage of cows by comfort parameter and by type of stall base

Percent Cows

Type of Stall Base

	Concrete		Dirt		Rubber Mat		Mattress		Other	
Parameter	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Perching	8.5	(1.1)	9.4	(1.6)	6.9	(1.5)	5.9	(0.6)	9.6	(1.6)
Standing	7.9	(1.9)	6.6	(1.3)	18.7	(5.5)	10.8	(1.4)	10.3	(3.3)
Lying	35.2	(3.3)	39.8	(3.2)	27.2	(5.5)	42.9	(3.2)	40.9	(3.6)
CCI	68.2	(3.6)	71.3	(3.8)	51.6	(7.7)	72.0	(2.4)	67.3	(4.4)

Photo courtesy of Dr. Jason Lombard

The percentages of cows perching were similar across all bedding types. Standing in stalls was observed for a lower percentage of cows when straw, coarse sand, composted manure, or no bedding was used compared with most other bedding types. A higher percentage of cows were lying when in stalls bedded with coarse sand (48.0 percent) compared with cows in stalls bedded with straw, composted or dried manure, or "other" bedding types (33.6, 30.2, 28.5, and 30.8 percent, respectively). With the exception of composted manure, the CCI was highest for operations that bedded with coarse sand compared with all other bedding types.

c. Percentage of cows by comfort parameter and by bedding type

	Percent Cows													
	Bedding Type													
	Straw		Sawdust		Fine Sand		Coarse Sand		Composted Manure		Dried Manure		Other*	
Para-meter	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Perching	8.4	(1.5)	7.2	(0.7)	9.0	(1.2)	7.5	(0.8)	9.4	(2.8)	15.6	(7.6)	5.9	(0.9)
Standing	6.6	(1.4)	14.9	(2.6)	10.7	(2.8)	5.1	(1.4)	2.9	(1.1)	14.1	(4.4)	10.4	(2.4)
Lying	33.6	(4.6)	42.1	(2.8)	39.3	(3.6)	48.0	(3.6)	30.2	(6.8)	28.5	(6.7)	30.8	(4.1)
CCI	69.0	(3.6)	65.6	(3.4)	66.6	(4.4)	79.2	(2.0)	71.1	(3.6)	49.0	(12.4)	65.4	(4.7)

*Includes shredded newspaper.

Days since bedding was changed was not associated with perching, standing, or CCI. A higher percentage of cows on operations that had changed bedding 1 to 2 days before the assessment were lying (46.8 percent) compared with cows on operations on which bedding was changed 7 or more days before the assessment (34.5 percent). Increased frequency of bedding changes was not always associated with an increased percentage of cows lying or increased CCI.

d. Percentage of cows by comfort parameter and by number of days since bedding was added/changed

	Percent Cows									
	Number of Days									
	Less than 1		1 to 2		3 to 4		5 to 6		7 or More	
Parameter	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Perching	5.9	(3.1)	8.8	(0.8)	7.6	(1.8)	7.3	(1.1)	9.4	(1.7)
Standing	10.3	(3.0)	10.0	(1.8)	6.5	(1.3)	9.6	(4.2)	10.7	(2.4)
Lying	28.0	(11.9)	46.8	(2.8)	38.3	(3.6)	38.4	(4.8)	34.5	(2.9)
CCI	63.5	(10.6)	71.3	(2.2)	73.1	(3.9)	69.5	(6.6)	63.2	(4.9)

The percentage of cows perching in stalls was higher when the stall base was not exposed, bedding level with curb or base not exposed, bedding slightly dished out (8.2 and 10.2 percent, of cows, respectively) than when the stall base was less than 50 percent exposed (6.0 percent). Bedding quantity/stall condition was not associated with standing or lying parameters. The CCI was higher when bedding was level with the curb (74.2 percent) than when bedding was slightly dished out or more than 50 percent of the base was exposed (63.7 and 66.2 percent, respectively).

e. Percentage of cows by comfort parameter and by bedding quantity/stall condition in the majority of stalls

	Percent Cows							
	Bedding Quantity/Stall Condition							
	Base not Exposed, Bedding Level with Curb		Base not Exposed, Bedding Slightly Dished Out		Base Exposed (Less than 50 Percent)		Base Mostly Exposed (More than 50 Percent)	
Parameter	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Perching	8.2	(0.6)	10.2	(1.6)	6.0	(0.7)	6.6	(1.0)
Standing	7.3	(1.4)	10.3	(2.0)	11.0	(2.8)	11.8	(2.5)
Lying	44.7	(2.7)	35.9	(2.8)	36.0	(3.4)	36.0	(5.7)
CCI	74.2	(2.1)	63.7	(3.9)	67.9	(4.5)	66.2	(3.5)

Stall length was not associated with any comfort parameter.

f. Percentage of cows by comfort parameter and by average stall length

	Percent Cows									
	Average Stall Length (Inches)									
	Less than 82.0		82.0–85.9		86.0–91.9		92.0–95.9		96.0 or More	
Parameter	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Perching	7.8	(1.5)	9.6	(1.2)	7.7	(1.0)	7.8	(1.0)	6.3	(1.4)
Standing	6.8	(1.8)	7.4	(1.5)	11.6	(2.6)	14.4	(6.4)	12.1	(2.8)
Lying	29.6	(5.8)	45.5	(3.7)	38.4	(2.5)	40.3	(7.0)	47.3	(3.8)
CCI	66.9	(4.4)	72.8	(3.3)	66.5	(3.5)	64.5	(10.7)	72.0	(3.8)

Photo courtesy of Dr. Jason Lombard

There were no differences in the percentage of cows perching or standing in stalls based on stall width. The percentage of cows lying was higher on operations with stall widths of 50.0 inches or more (58.6 percent) compared with the percentage of cows on operations in which stall widths were less than 50.0 inches. Although a linear trend was not observed, the CCI was higher for stall widths of 50.0 inches or more compared with stall widths of 44.0 to 45.9 inches and 48.0 to 49.9 inches.

g. Percentage of cows by comfort parameter and by average stall width

	Percent Cows											
	Average Stall Width (Inches)											
	Less than 42.0		42.0–43.9		44.0–45.9		46.0–47.9		48.0–49.9		50.0 or More	
Parameter	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Perching	7.8	(1.1)	7.8	(0.8)	9.4	(1.5)	7.1	(1.0)	7.2	(1.4)	11.2	(1.5)
Standing	7.4	(2.0)	7.7	(1.7)	12.3	(1.9)	9.6	(2.6)	6.7	(2.2)	9.0	(1.6)
Lying	35.9	(7.0)	39.1	(3.2)	40.2	(2.4)	35.7	(4.0)	25.9	(4.8)	58.6	(7.2)
CCI	70.2	(2.3)	71.7	(2.7)	65.0	(3.8)	68.1	(4.3)	65.1	(4.5)	74.4	(1.0)

The type or presence of a neck rail did not impact the percentage of cows perching or the CCI. A lower percentage of cows were standing in the stall when no neck rail was present (4.0 percent) compared with either the presence of a stationary or moveable neck rail (9.7 and 11.9 percent, respectively). Similarly, a lower percentage of cows were lying when no neck rail was present compared with operations with stationary or moveable neck rails.

h. Percentage of cows by comfort parameter and by neck rail type

	Percent Cows					
	Neck Rail Type					
	Stationary		Moveable		None	
Parameter	Percent	Std. Error	Percent	Std. Error	Percent	Std. Error
Perching	7.8	(0.5)	13.7	(4.3)	5.5	(1.3)
Standing	9.7	(1.2)	11.9	(2.9)	4.0	(1.2)
Lying	38.3	(1.8)	36.2	(7.1)	19.6	(4.1)
CCI	68.7	(2.0)	58.6	(8.1)	67.4	(5.1)

There were no differences in comfort parameters based on neck rail distance from the curb.

i. Percentage of cows by comfort parameter and by average distance from neck rail to curb

	Percent Cows							
	Average Distance (Inches)							
	Less Than 60.0		60–65.9		66.0–71.9		72.0 or More	
Parameter	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Perching	6.5	(0.8)	8.7	(0.7)	9.1	(1.8)	6.2	(1.1)
Standing	11.6	(4.1)	9.0	(1.7)	9.8	(1.4)	11.1	(2.9)
Lying	40.4	(6.0)	35.5	(2.3)	42.6	(3.2)	38.4	(5.9)
CCI	69.1	(5.6)	66.8	(2.8)	69.3	(3.7)	68.8	(4.9)

Neck rail height was not associated with any of the reported comfort parameters.

j. Percentage of cows by comfort parameter and by average distance from neck rail to bedding surface

	Percent Cows							
	Average Distance (Inches)							
	Less than 40		40.0–45.9		46.0–49.9		50.0 or More	
Parameter	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Perching	7.4	(0.8)	8.2	(0.6)	9.8	(2.2)	6.0	(1.5)
Standing	9.2	(1.9)	8.9	(1.5)	11.9	(2.5)	10.6	(5.1)
Lying	34.9	(4.4)	39.7	(2.3)	41.3	(3.3)	27.5	(9.1)
CCI	67.8	(3.6)	70.0	(2.5)	65.6	(4.7)	62.4	(8.6)

The presence of a brisket locator or the locator material did not affect the percentage of cows that were perching, standing, or the CCI. However, operations that did not have a brisket locator had a lower percentage of cows lying (32.6 percent) compared with operations that had brisket locators made of wood (41.9 percent) or PVC or other plastic pipe (46.4 percent).

k. Percentage of cows by comfort parameter and by type of brisket locator

	Percent Cows									
	Type of Brisket Locator									
	Concrete		Wood		PVC or Other Plastic Pipe		Other		None	
Parameter	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Perching	7.2	(1.8)	8.2	(0.7)	6.3	(1.2)	7.6	(1.0)	9.2	(1.4)
Standing	12.3	(5.8)	9.9	(1.7)	13.8	(4.4)	8.5	(2.5)	8.4	(1.6)
Lying	38.7	(6.3)	41.9	(2.6)	46.4	(3.5)	42.8	(5.5)	32.6	(2.9)
CCI	66.5	(7.9)	69.9	(2.8)	69.7	(5.6)	72.7	(4.9)	64.9	(3.6)

The percentage of cows perching, standing, or lying was not different based on the distance of the brisket locator from the rear curb.

Operations with a distance of 66.0 to 67.9 inches from curb to brisket locator had the highest CCI (79.2 percent)

l. Percentage of cows by comfort parameter and by average distance from curb to brisket locator

	Percent Cows									
	Average Distance (Inches)									
	Less than 66.0		66.0–67.9		68.0–69.9		70.0–71.9		72.0 or More	
Parameter	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Perching	8.3	(1.1)	6.3	(0.7)	8.8	(1.4)	8.0	(1.4)	7.2	(1.2)
Standing	10.2	(3.6)	6.8	(1.4)	10.0	(2.5)	10.4	(2.3)	16.3	(5.0)
Lying	36.4	(4.8)	50.2	(3.5)	44.5	(3.8)	39.8	(3.4)	40.0	(4.6)
CCI	66.3	(6.0)	79.2	(2.5)	70.3	(3.0)	68.4	(2.7)	62.9	(7.1)

The presence of a lunge barrier or its material did not affect the percentage of cows standing or the CCI. Operations with a cable lunge barrier had the lowest percentage of cows perching (3.5 percent). Operations with a wood lunge barrier had a lower percentage of cows lying (30.8 percent) compared with "other" lunge barriers or no lunge barriers (43.4 and 41.8 percent, respectively).

m. Percentage of cows by comfort parameter and by lunge barrier material

	Percent Cows									
	Lunge Barrier Material									
	Concrete		Wood		Cable		Other		None	
Parameter	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Perching	9.8	(2.4)	8.2	(0.8)	3.5	(1.0)	8.6	(1.9)	8.5	(0.9)
Standing	6.0	(2.8)	7.6	(1.2)	8.9	(2.6)	11.8	(2.5)	10.5	(2.1)
Lying	32.2	(5.2)	30.8	(2.9)	37.6	(11.6)	43.4	(3.5)	41.8	(2.3)
CCI	67.1	(4.6)	66.1	(2.7)	75.2	(8.5)	68.1	(4.7)	68.7	(3.0)

Curb heights of 13.0 inches or more were associated with a lower percentage of cows perching (4.8 percent) and lying (25.5 percent) compared with curb heights of 8.0 to 12.9 inches. Curb height was not associated with the percentage of cows standing in stalls or with the CCI.

n. Percentage of cows by comfort parameter and by curb height

	Percent Cows					
	Curb Height (Inches)					
	Less than 8.0		8.0–12.9		13.0 or More	
Parameter	Percent	Std. Error	Percent	Std. Error	Percent	Std. Error
Perching	6.7	(0.9)	8.8	(0.8)	4.8	(1.2)
Standing	7.8	(2.0)	10.1	(1.3)	10.1	(3.7)
Lying	33.7	(4.3)	39.3	(2.0)	25.5	(5.6)
CCI	69.9	(4.1)	67.5	(2.3)	63.1	(7.3)

Photo courtesy of Dr. Jason Lombard

Curb width was not associated with any of the measured comfort parameters.

o. Percentage of cows by comfort parameter and by curb width

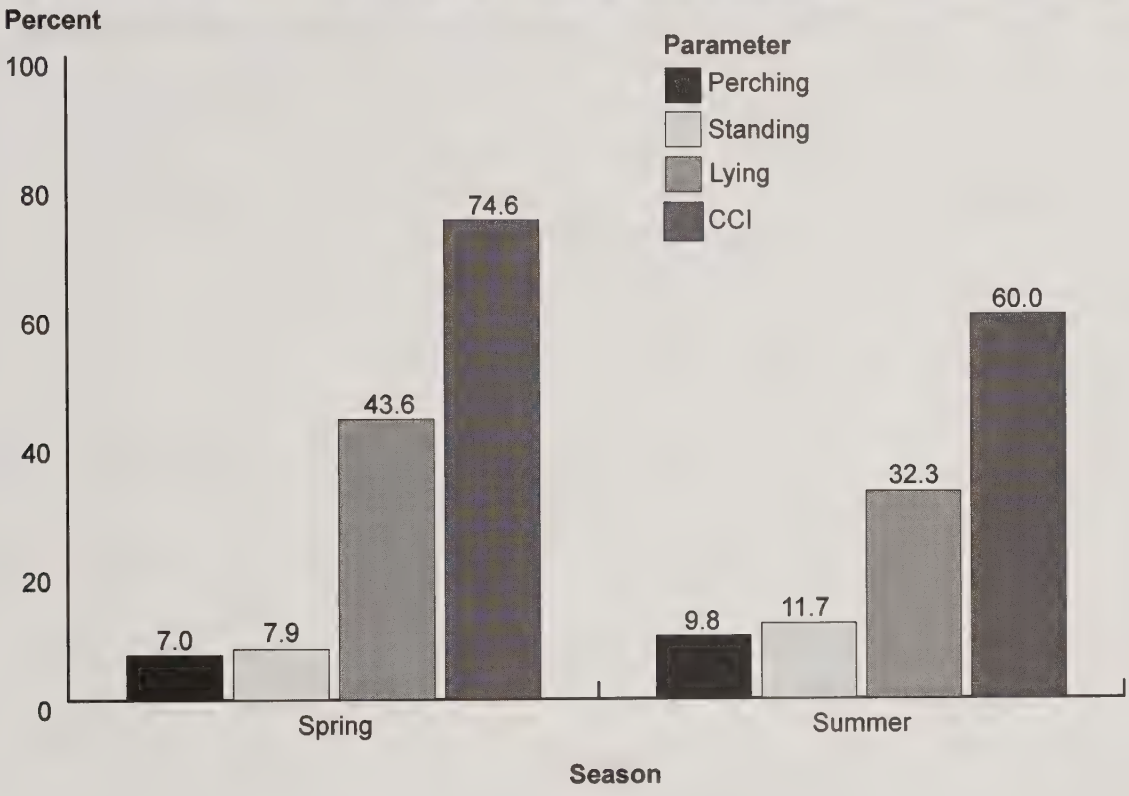
	Percent Cows					
	Curb Width (Inches)					
	Less than 6.0		6.0–8.9		9.0 or More	
Parameter	Percent	Standard Error	Percent	Standard Error	Percent	Standard Error
Perching	8.1	(1.1)	7.9	(0.8)	14.0	(5.2)
Standing	7.8	(1.7)	10.1	(1.7)	9.0	(3.4)
Lying	43.3	(4.3)	36.4	(2.5)	39.0	(5.4)
CCI	73.1	(3.1)	66.9	(2.7)	63.0	(10.6)

Season had a significant impact on the percentage of cows perching, lying, and on the CCI. The percentage of cows perching was lower in spring than in summer, while the percentage of cows lying and the CCI were higher in spring than in summer.

p. Percentage of cows by comfort parameter and by season

	Percent Cows			
	Season			
	Spring		Summer	
Parameter	Percent	Std. Error	Percent	Std. Error
Perching	7.0	(0.6)	9.8	(1.2)
Standing	7.9	(0.9)	11.7	(2.1)
Lying	43.6	(2.2)	32.3	(2.4)
CCI	74.6	(1.5)	60.0	(3.6)

Percentage of Cows by Comfort Parameter and by Season



Section III: Methodology

A. Needs Assessment

NAHMS develops study objectives by exploring existing literature and by contacting stakeholders about their informational needs and priorities during a needs-assessment phase. The objective of the needs assessment for the NAHMS Dairy 2007 study was to conduct a national survey to collect information from U.S. dairy producers and other dairy specialists about what they perceived to be the most important dairy health and productivity issues. A driving force of the needs assessment was the desire of NAHMS researchers to receive as much input as possible from a variety of producers, industry experts and representatives, veterinarians, extension specialists, universities, and dairy organizations.

Focus group teleconferences and meetings were held to help determine the focus of the study.

Teleconference, March 30, 2006
National Johne's Working Group

Louisville, KY, April 2, 2006
National Johne's Working Group
National Institute for Animal Agriculture

Louisville, KY, April 3, 2006
National Milk Producers Federation
Animal Health Committee

Teleconference, December 15, 2006
Bovine Alliance on Management and Nutrition

In addition, a needs-assessment survey was designed to ascertain the top-three management issues, diseases/disorders, and producer incentives from producers, veterinarians, extension personnel, university researchers, and allied industry groups. The survey, created in SurveyMonkey, was available online from early February through late April 2006.The survey was promoted via electronic newsletters, magazines, and Web sites. Organizations/ magazines promoting the study included "Dairy Herd Management–Dairy Alert," "Dairy Today," "Hoard's Dairyman," NMC, "Journal of the American Veterinary Medical Association," and the American Association of Bovine Practitioners. Email messages were also sent to cooperative members of the National Milk Producers Federation as well as State and Federal personnel. A total of 313 people completed the survey. Universities/extensions accounted for 23 percent of respondents, producers accounted for 22 percent, and veterinarians/consultants accounted for another 20 percent.

Fort Collins, CO, May 18, 2006
CEAH Focus Group meeting

Draft objectives for the Dairy 2007 study, using input from teleconferences, face-to-face meetings, and the online survey, were drafted prior to the focus group meeting. Attendees included producers, veterinarians, and university/extension and government personnel. The day-long meeting culminated in the formulation of eight objectives for the study:

1. Describe trends in dairy cattle health and management practices,

2. Evaluate management factors related to cow comfort and removal rates,
3. Describe dairy calf health and nutrition from birth to weaning and evaluate heifer disease prevention practices,
4. Estimate the prevalence of herds infected with bovine viral diarrhea virus (BVD),
5. Describe current milking procedures and estimate the prevalence of contagious mastitis pathogens,
6. Estimate the herd-level prevalence and associated costs of *Mycobacterium avium* subspecies *paratuberculosis* (Johne's disease),
7. Describe current biosecurity practices and determine producer motivation for implementing or not implementing biosecurity practices, and
8. Determine the prevalence of specific food safety pathogens and describe antimicrobial resistance patterns.

B. Sampling and Estimation

1. State selection

The preliminary selection of States to be included in the study was done in February 2006, using the National Agricultural Statistics Service (NASS) January 27, 2006, Cattle Report. A goal for NAHMS national studies is to include States that account for at least 70 percent of the animals and producer population in the United States. The initial review of States identified 16 major States representing 82.0 percent of the milk cow inventory and 79.3 percent of the operations with milk cows (dairy herds). The States were: California, Idaho, Indiana, Iowa, Kentucky, Michigan, Minnesota, Missouri, New Mexico, New York, Ohio, Pennsylvania, Texas, Vermont, Washington, and Wisconsin.

A memo identifying these 16 States was provided in March 2006 to the USDA-APHIS-VS-CEAH Director and, in turn, the VS Regional Directors. Each Regional Director sought input from the respective States about being included or excluded from the study. Virginia expressed interest in participating and was included, bringing the total number of States to 17.

2. Operation selection

The list sampling frame was provided by NASS. Within each State a stratified random sample was selected. The size indicator was the number of milk cows for each operation. NASS selected a sample of dairy producers in each State for making the January 1 cattle estimates. The list-based sample from the January 2006 survey was used as the screening sample. Among those producers reporting 1 or more milk cows on January 1, 2006, a total of 3,554 operations were selected in the sample for contact in January 2007 during Phase I. Operations with 30 or more dairy cows that had participated in Phase I were invited to participate in data collection for Phase II. A total of 1,077 operations agreed to be contacted by Veterinary Medical Officers (VMOs) to determine whether to complete Phase II.

3. Population inferences

a. Phase I: General Dairy Management Report

Inferences cover the population of dairy producers with at least 1 milk cow in the 17 participating States. As of January 1, 2007, these States accounted for 82.5 percent (7,536,000 head) of milk cows and 79.5 percent (59,640) of operations with milk cows in the United States. (See Appendix II for respective data on individual States.) All respondent data were statistically weighted to reflect the population from which they were selected. The inverse of the probability of selection for each operation was the initial selection weight. This selection weight was adjusted for nonresponse within each State and size group to allow for inferences back to the original population from which the sample was selected.

b. Phase II: VS Initial and Second Visits

For operations eligible for Phase II data collection (those with 30 or more dairy cows), weights were adjusted to account for operations that did not want to continue to Phase II. In addition, weights were adjusted for nonresponse to the questionnaire in each visit. The 17-State target population of operations with 30 or more dairy cows represented 82.5 percent of dairy cows and 84.7 percent of dairy operations (Appendix II).

C. Data Collection

1. Phase I: General Dairy Management Report

From January 1 to 31, 2007, NASS enumerators administered the General Dairy Management Report questionnaire. The interview took slightly more than 1 hour.

2. Phase II: VS Initial Visit

From February 26 to April 30, 2007, Federal and State Veterinary Medical Officers (VMOs) and/or Animal Health Technicians (AHTs) collected data from producers during an interview that lasted approximately 2 hours.

3. Phase II: VS Second Visit

From May 1 to August 31, 2007, Federal and State VMOs and/or AHTs collected data from producers during an interview that lasted approximately 2 hours.

D. Data Analysis

1. Validation

a. Phase I: Validation—General Dairy Management Report

Initial data entry and validation for the General Dairy Management Report were performed in individual NASS State offices. Data were entered into a SAS data set. NAHMS national staff performed additional data validation on the entire data set after data from all States were combined.

b. Phase II: Validation—VS Initial and Second Visit Questionnaires

After completing the VS Initial and Second Visit questionnaires, data collectors sent them to their respective State NAHMS Coordinators, who reviewed the questionnaire responses for accuracy and sent them to NAHMS. Data entry and validation were completed by NAHMS staff using SAS.

E. Sample Evaluation

The purpose of this section is to provide various performance measurement parameters. Historically, the term "response rate" has been used as a catchall parameter, but there are many ways to define and calculate response rates. Therefore, the following tables present an evaluation based upon a number of measurement parameters, which are defined with an "x" in categories that contribute to the measurement.

1. Phase I: General Dairy Management Report

A total of 3,554 operations were selected for the survey. Of these operations, 3,304 (93.0 percent) were contacted. There were 2,519 operations that provided usable inventory information (70.9 percent of the total selected and 76.2 percent of those contacted). In addition, there were 2,194 operations (61.7 percent) that provided "complete" information for the questionnaire. Of operations that provided complete information and were eligible to participate in Phase II of the study (2,067 operations), 1,077 (52.1 percent) consented to be contacted for consideration/ discussion about further participation.

Responses for Phase I: General Dairy Management Report

			Measurement Parameter		
Response Category	Number Operations	Percent Operations	Contacts	Usable[1]	Complete[2]
Survey complete and VMO consent	1,077	30.3	x	x	x
Survey complete, refused VMO consent	990	27.9	x	x	x
Survey complete, ineligible[3] for VMO	127	3.6	x	x	x
No dairy cows on January 1, 2007	214	6.0	x	x	
Out of business	111	3.1	x	x	
Out of scope	6	0.2			
Refusal of GDMR	785	22.1	x		
Office hold (NASS elected not to contact)	126	3.5			
Inaccessible	118	3.3			
Total	3,554	100.0	3,304	2,519	2,194
Percent of total operations			93.0	70.9	61.7
Percent of total operations weighted[4]			94.0	74.1	59.6

[1]Usable operation—respondent provided answers to inventory questions for the operation (either zero or positive number on hand).
[2]Survey complete operation—respondent provided answers to all or nearly all questions.
[3]Ineligible—fewer than 30 head of milk cows on January 1, 2007.
[4]Weighted response—the rate was calculated using the initial selection weights.

2. Phase II: VS Initial Visit

There were 1,077 operations that agreed to be contacted by a VMO during Phase I. Of these 1,077 operations, 582 (54.0 percent) agreed to continue in Phase II of the study and completed the VS Initial Visit questionnaire; 380 (35.3 percent) refused to participate. Approximately 10 percent of the 1,077 operations were not contacted, and 0.4 percent were ineligible because they had no dairy cows at the time they were contacted.

Responses for Phase II: VS Initial Visit

			Measurement Parameter		
Response Category	Number Operations	Percent Operations	Contacts	Usable[1]	Complete[2]
Survey complete	582	54.0	x	x	x
Survey refused	380	35.3	x		
Not contacted	111	10.3			
Ineligible[3]	4	0.4	x	x	
Total	1,077	100.0	966	586	582
Percent of total operations			89.7	54.4	54.0
Percent of total operations weighted[4]			87.5	50.8	50.4

[1]Usable operation—respondent provided answers to inventory questions for the operation (either zero or positive number on hand).
[2]Survey complete operation—respondent provided answers to all or nearly all questions.
[3]Ineligible—no dairy cows at time of interview, which occurred from February 26 through April 30, 2007
[4]Weighted response—the rate was calculated using the turnover weights.

3. Phase II: VS Second Visit

Of the 582 operations that completed the VS Initial Visit Questionnaire, 519 (including one operation that did not complete the VS Initial Visit on time) completed the VS Second Visit questionnaire; 47 (8.1 percent) refused to participate. Approximately 3 percent of the 583 operations were not contacted, and 0.3 percent were ineligible because they had no dairy cows at the time of the VS Second Visit.

Responses for Phase II: VS Second Visit

			Measurement Parameter		
Response Category	Number Operations	Percent Operations	Contacts	Usable[1]	Complete[2]
Survey complete	519	89.0	x	x	x
Survey refused	47	8.1	x		
Not contacted	15	2.6			
Ineligible[3]	2	0.3	x	x	
Total	583	100.0	568	521	519
Percent of total operations			97.4	89.4	89.0
Percent of total operations weighted[4]			98.1	90.6	90.3

[1]Usable operation—respondent provided answers to inventory questions for the operation (either zero or positive number on hand).
[2]Survey complete operation—respondent provided answers to all or nearly all questions.
[3]Ineligible—no dairy cows at time of interview, which occurred from May 1 through August 31, 2007.
[4]Weighted response—the rate was calculated using the turnover weights..

Appendix I: Sample Profile

Responding Operations

a. Number of responding operations by herd size

Herd Size (Number of Cows)	Phase I: General Dairy Management Report	Phase II: VS Initial Visit	Phase II: VS Second Visit	Cow Comfort Assessment
Fewer than 100	1,028	233	211	187
100 to 499	691	215	188	179
500 or more	475	134	120	119
Total	2,194	582	519	485

b. Number of responding operations by region

Region	Phase I: General Dairy Management Report	Phase II: VS Initial Visit	Phase II: VS Second Visit	Cow Comfort Assessment
West	426	108	93	81
East	1,768	474	426	404
Total	2,194	582	519	485

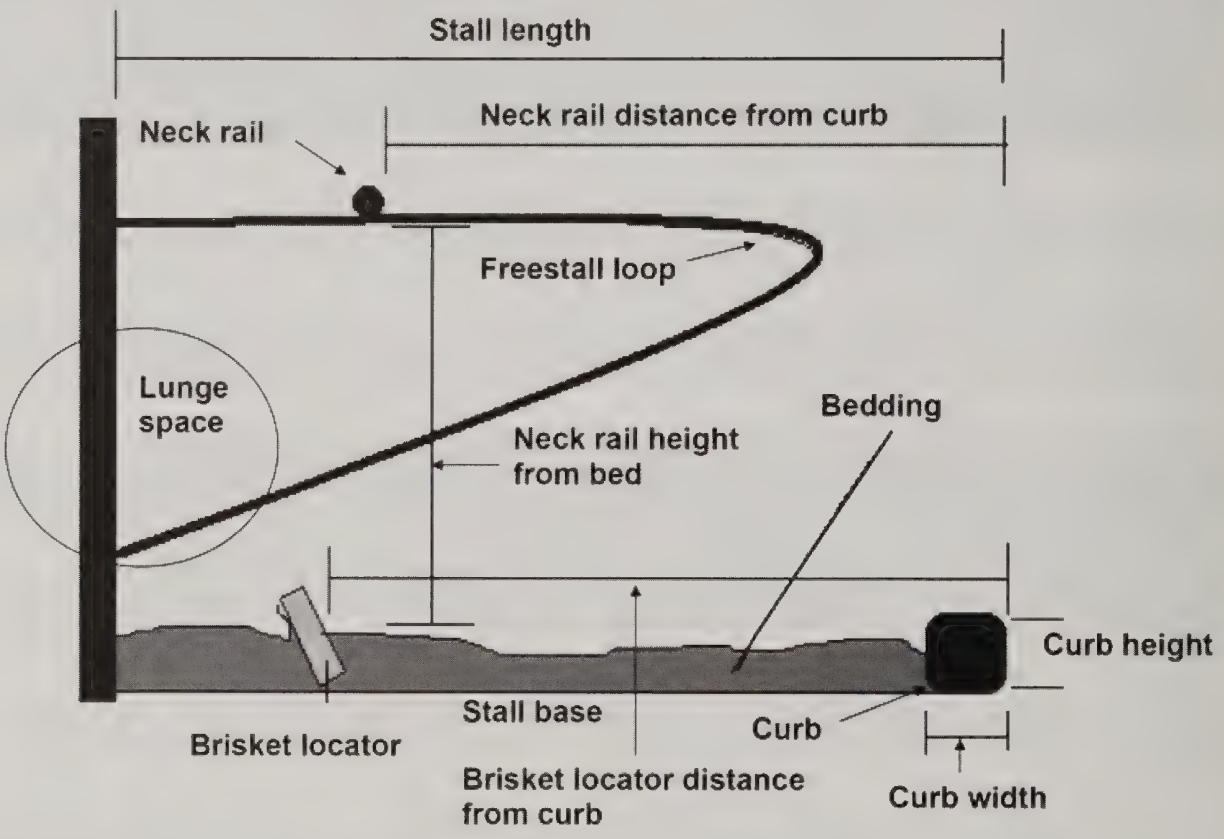
Appendix II: U.S. Milk Cow Population and Operations

Number of milk cows on January 1, 2007*

		Number of Milk Cows, January 1, 2007 (Thousand Head)		Number of Operations 2006		Average Herd Size	
Region	State	Milk Cows on Operations with 1 or More Head	Milk Cows on Operations with 30 or More Head	Operations with 1 or More Head	Operations with 30 or More Head	Operations with 1 or More head	Operations with 30 or More Head
West	California	1,790	1,788.2	2,200	1,920	813.6	931.4
	Idaho	502	501.0	800	620	627.5	808.1
	New Mexico	360	358.9	450	180	800.0	1,993.9
	Texas	347	344.2	1,300	660	266.9	521.5
	Washington	235	234.3	790	540	297.5	433.9
	Total	3,234	3,226.6	5,540	3,920	583.8	823.1
East	Indiana	166	154.4	2,100	1,150	79.0	134.3
	Iowa	210	203.7	2,400	1,870	87.5	108.9
	Kentucky	93	86.5	2,000	1,180	46.5	73.3
	Michigan	327	320.5	2,700	1,910	121.1	167.8
	Minnesota	455	441.3	5,400	4,800	84.3	91.9
	Missouri	114	108.3	2,600	1,400	43.8	77.4
	New York	628	612.3	6,400	5,100	98.1	120.1
	Ohio	274	252.1	4,300	2,400	63.7	105.0
	Pennsylvania	550	536.3	8,700	7,000	63.2	76.6
	Vermont	140	137.2	1,300	1,100	107.7	124.7
	Virginia	100	97.0	1,300	820	76.9	118.3
	Wisconsin	1,245	1,213.9	14,900	12,800	83.6	94.8
	Total	4,302	4,163.5	54,100	41,530	79.5	100.3
Total (17 States)		7,536	7,390.1	59,640	45,450	126.4	162.6
Percent of U.S.		82.5	82.5	79.5	84.7		
Total U.S. (50 States)		9,132.0	8,958.5	74,980	53,680	121.8	166.9

*Source: NASS Cattle report, February 1, 2008, and NASS Farms, Land in Farms, and Livestock Operations 2007 Summary report, February 1, 2008. An operation is any place having one or more head of milk cows, excluding cows used to nurse calves, on hand at any time during the year.

Appendix III: Typical Freestall Components and Dimensions



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